Vol. 6 FEBRUARY, 1925 No. 1

FEB 24 1925

ENCE LIBRARY

JOURNAL OF MAMMALOGY

Published Quarterly by the American Society of Mammalogists

CONTENTS

		PAGE
Ned Hollister	*Wilfred H. Osgood*	1
The Hair Pattern of a Kangaroo, a Study of Cause and Effect	*Frederic Wood Jones*	13
How Squirrels and Other Rodents Carry Their Young	*Herbert Lang*	18
The Scientific Value of Predatory Mammals	*Lee R. Dice*	25
The Predatory Mammal Problem and the Balance of Nature	*E. A. Goldman*	28
Food Predilections of Predatory and Fur-bearing Mammals	*Joseph Dixon*	34
On the Study of Scatology	*Ernest Thompson Seton*	47
A New Hog-nosed Skunk	*Frederic W. Miller*	50
Preliminary Descriptions of Five New Chipmunks from North America	*Arthur H. Howell*	51
General Notes		55

The Sorex arcticus and Sorex arcticus obscurus of Kerr, *Hartley H. T. Jackson*. Some Physiological Observations on Captive Skunks, *M. M. Ellis and O. W. Barlow*. Some New Rodent Records for Northeastern California, *J. Mendenall*. Weights of Mammalian Gonads, *W. H. Leopold*. The Bridled Dolphin (Prodelphinus frenatus) on the Florida Coast, *Glover M. Allen*. The systematic name of the Texas Armadillo, *N. Hollister*.

Recent Literature		61

PRINTED BY

WILLIAMS & WILKINS COMPANY

MOUNT ROYAL AND GUILFORD AVENUES

BALTIMORE, MARYLAND

Entered as second-class matter, November 22, 1919, at the Postoffice, Baltimore, Md., under the Act of March 3, 1879.

The American Society of Mammalogists

Founded April 3, 1919
Incorporated April 29, 1920

WILFRED H. OSGOOD, *President*
W. D. MATTHEW; GLOVER M. ALLEN, *Vice-Presidents*
H. H. LANE, *Recording Secretary*
HARTLEY H. T. JACKSON, *Corresponding Secretary*
ARTHUR J. POOLE, *Treasurer*
GERRIT S. MILLER, JR., *Editor*

Additional Directors

1923–1925	1924–1926
WITMER STONE	T. S. PALMER
JOSEPH GRINNELL	M. W. LYON, JR.
JOHN C. MERRIAM	RUDOLPH M. ANDERSON
H. E. ANTHONY	CHAS. C. ADAMS
E. A. GOLDMAN	JOSEPH DIXON

C. HART MERRIAM, E. W. NELSON } Past-Presidents

Trustees

HENRY BANNON — CHILDS FRICK — CHARLES SHELDON

Standing Committees

Publications: Gerrit S. Miller, Jr., *Chairman.* Edward A. Preble, Hartley H. T. Jackson, William H. Cheesman.

Life Histories of Mammals: Walter P. Taylor, *Chairman.* Chas. C. Adams, Vernon Bailey.

Anatomy and Phylogeny: Adolph H. Schultz, *Chairman.* John C. Merriam, W. K. Gregory, J. W. Gidley, A. Brazier Howell.

Bibliography: Lee R. Dice, *Chairman.* Homer H. Collins, Malcolm R. Thorpe, George Wagner, E. A. Goldman.

Marine Mammals: T. S. Palmer, *Chairman.* Gerrit S. Miller, Jr., Barton W. Evermann, Robert Cushman Murphy, Glover M. Allen.

Economic Mammalogy: A. K. Fisher, *Chairman.* W. B. Bell, Harold C. Bryant.

J. A. Allen Memorial: Madison Grant, *Chairman.* Henry Fairfield Osborn, Childs Frick, George Bird Grinnell, H. E. Anthony.

The Journal of Mammalogy

Subscription rates, $3.50 per year; single numbers $1.00 each. Sent free to all members of the American Society of Mammalogists not in arrears for dues.

Manuscripts for publication, books and papers for notice and review, etc., should be sent to the Editor, Gerrit S. Miller, Jr., U. S. National Museum, Washington, D. C.

Subscriptions, changes of addresses, requests for missing numbers, applications for advertising rates, etc., should be sent to the Corresponding Secretary, Dr. Hartley H. T. Jackson, Biological Survey, Washington, D. C.

NED HOLLISTER

JOURNAL OF MAMMALOGY

Published Quarterly by the American Society of Mammalogists

VOL. 6 FEBRUARY, 1925 No. 1

NED HOLLISTER

[BORN NOVEMBER 26, 1876—DIED NOVEMBER 3, 1924]

BY WILFRED H. OSGOOD

[*Plates 1–2*[1]]

Although Ned Hollister's death occurred before his years had reached the half century mark, the consciousness that he is gone brings pangs similar to those evoked by the passing of older naturalists belonging to another generation. He was one of those heart-and-soul, born lovers of animals, who carry not only an affectionate sympathy for living things but also a passion for orderly knowledge of them—one of those whose career began in boyhood with the formation of a collection of his own and led on, without benefit of school or college, to mastery of difficult technical subjects as naturally and easily as if he had been ordained for it.

He was born November 26, 1876, in Delavan, Wisconsin, the youngest of a family including also two brothers, Warren D. and Kenneth, and a sister, Margaret. His forbears were of English blood, one of the better known of them being Lieut. John Hollister, who came to America in 1642 and was later prominent in the colonial affairs of Connecticut. His grandfather was a native of New York State and thence, in 1839, migrated to southern Wisconsin where he settled in Rock Prairie, Walworth County. His father, Kinner Newcomb Hollister, was born near Delavan on a farm which he continued to own after moving

[1] Plate 1, portrait by Harris and Ewing, 1917; Plate 2, photographs taken at the Washington Biologists Field Club, 1921–22, by Mr. C. R. Shoemaker and here reproduced through the kindness of friends.

into town and opening a store. He sold this business to enter the Civil War, where he was commissioned Captain, and after the war returned to Delavan to continue in a general merchandise business until his death in 1911. Ned's mother, Frances Margaret (Tilden) Hollister, is still living in Delavan. They belonged to that class of well-informed, prosperous and independent people which makes nations great, engaged mainly in farming or local business connected with farming. Their home was one in which nothing essential was lacking, and while the great outdoors was always at hand, it was supplemented by the social and educational advantages of the village and by proximity to the two large cities, Chicago and Milwaukee.

Ned's formal education was confined to the public schools of Delavan, where he had the usual high school training but failed actually to graduate, a collecting trip having conflicted with the last few days of the school year. Although he did not go to college, early associations were made by which his natural tendencies received all that was necessary to give him an understanding of scientific method and an appreciation of absolute accuracy exceeding that of many college-trained men. One of the first of these profitable contacts was with Prof. Ludwig Kumlien of Milton College in the small town of Milton, Wisconsin, not far from Delavan. Some years later, after Kumlien's death, Hollister was visiting the laboratory with his friend, Hartley Jackson, who relates that Ned made reference at that time to his lack of college training with a certain wistfulness which was covered by a characteristic jocular allusion to the college diploma as a "sheep pelt."

It is not uncommon for naturalists to show their inclinations early in life and they often make real contributions to knowledge while still in their teens, but few if any have begun earlier than Ned Hollister. In his joint work with L. Kumlien on *The Birds of Wisconsin*, published in 1903, it is stated that conclusions were based on thirty-five years' field work by the senior author and fifteen by the junior. This implies that Hollister regarded his field work as beginning when he was twelve years old. If he says so, we may be quite sure it did, not theoretically but actually, and the statement in *The Birds of Wisconsin* undoubtedly means that at least some of the matter published in the book was founded by definite observations or notes made by the boy of twelve. Further evidence is shown by the fact that he began publishing in his sixteenth year, in 1892, when three papers appeared under his name, one in *The Oologist* and two in a leaflet called *The Taxidermist*.

Early birdsnesting and taxidermic efforts were made in the company

of his brother Warren, and the collection of birds, eggs, and latterly of mammals which was brought together was a joint affair, Warren only relinquishing his interest after he had left home and entered an active life of business. Young Ned and his brother evidently were favorites among a coterie of sportsmen citizens of Delavan who took them on their semi-annual shooting parties to the nearby lakes and prairies where ducks, snipe and other gamebirds abounded. His father encouraged him, and an uncle, Mr. F. E. Burrows, often accompanied him to photograph birds' nests. On his father's farm near Delavan were several duck "holes" which furnished him a private preserve, and on family farms in Minnesota and Florida, he had welcome headquarters for hunting and collecting. These early hunting associations were very dear to Hollister and in later years, long after he had become immersed in scientific study and executive work in Washington, he returned to Delavan practically every season to shoot over the old ground and visit with what he affectionately and truly termed "the old crowd," for most of them were much older than he.

The life in Delavan, the early collecting, and the hunting parties with older men formed an important part of Hollister's background. Good sportsmanship, manliness, loyalty, camaraderie, judgment, and fun-loving humor were qualities which he possessed by nature, but doubtless their development was assisted by these associations. There was another and more intense side to him, however, and this also had a favorable environment. He was the heir, so to speak, of a line of pioneer naturalists in southern Wisconsin which included Lapham, Hoy, Thurè Kumlien and Ludwig Kumlien. The last was the one to form the connection and he exerted an important influence upon Hollister when he was at the critical age of nineteen.

Kumlien was then teaching in Milton College and, although Hollister was not a student of the college, he "walked with" Kumlien to better purpose than many of those who were. Shortly after this, Hartley Jackson, now a well known mammalogist but then a boy of sixteen and four years younger than Ned, came to Milton College as a student and the two were brought together by Kumlien. After Kumlien's early death, Hollister became a mentor for Jackson as Kumlien had been for him, and later was instrumental in bringing Jackson to his present position with the Biological Survey. Probably through Kumlien, he became acquainted with others, including members of the Wisconsin Natural History Society, among whom were Dr. H. V. Ogden, Dr. Ernst Copeland and Dr. G. W. Peckham of Milwaukee. As early as

1892, he was in touch with the United States Department of Agriculture and began collecting birds' stomachs to assist the government work in economic ornithology. It was in this year, also, that he began earnestly to collect birds' skins as well as eggs and was soon exchanging and corresponding with many prominent ornithologists. One of them was William Brewster, whose well known warmth toward younger men soon caused Hollister to send him various specimens for determination and to ask his advice on matters concerning them. Just how Hollister would have developed without these favorable influences is uncertain, but one cannot avoid wondering what would be the fate of a boy like him in present times when, with rare exceptions, there are no Kumliens in our small colleges and no Brewsters forming private collections. Even as it was, he did not find himself immediately, and for several years after reaching his majority he remained in Delavan assisting in the general store kept by his father. Meanwhile, all spare time was devoted to his collections and short trips were made at all opportunities. In 1896 and 1897 he had outings in Minnesota near the town of Kinbrae, and for three succeeding winters a few weeks were spent in Arkansas in Loneoak, Arkansas and Prairie counties. At this period his interest in mammals had been awakened and he made his first mammal skins for permanent preservation in 1896. At the same time, he began compiling a list of the species of Walworth County, Wisconsin.

In March, 1901, Ned made an eastern trip to visit the Smithsonian Institution and National Museum, places which had been enshrined in his boyhood fancies. He was always very modest and doubtless made no advances to any of the men he met in Washington, but the following summer he was invited to join a Biological Survey party in Texas as assistant to Vernon Bailey. The appointment was for temporary service only, and he gladly accepted for a period of four months, June to September inclusive. In later years, he often related with much good humor the trepidation with which he went to meet the famous naturalist, whose name he had seen so frequently in print and whose prowess as a traveler and discoverer of new mammals had seemed to portend a man of extraordinary physique and commanding, perhaps domineering, character. Ned was by no means provincial, but in such reminiscences always represented himself to be; and it was this that gave point to his amusing description of his surprise when he found Mr. Bailey to be a man no larger than himself, quick, wiry and active, unassuming and sympathetic. Ned's keen sense of humor was also titillated on this occasion by the fact that Bailey suggested they have a

conference in a quiet place and for this purpose chose the cemetery in the little village of Jefferson, Texas. He worked with Bailey for a time and came to have great admiration for him. Soon proving competent for independent assignments he made important collections of mammals and birds at Joaquin, Sour Lake, Comstock, Fort Stockton, and Davis Mts., Texas, as well as at Weed, Cloudcroft, Ruidoso, Roswell and Fort Sumner, New Mexico.

In the fall of 1902, he returned to Delavan, went for a deer hunt in Vilas County, Wisconsin, and then, evidently intending to continue as a private collector, he bought the Kumlien collection of about 1500 specimens and added it to his own in February, 1903. Kumlien's death in December, 1902, after a long illness, was a sad blow, and the *Birds of Wisconsin*, on which the two had been working for years, was left to be completed by Hollister. The winter of 1902-1903, therefore, was spent largely on this work and the book appeared in July, 1903, a model of care and accuracy. Although a dozen or more notes and short articles had appeared previously, this was his first lengthy publication.

In the spring of 1903, the question of temporary field assistants again arose in the office of the Biological Survey, this time in connection with an Alaskan trip to which I had been assigned. After a word with Mr. Bailey, I quickly decided that Ned Hollister was the man I wanted and at once made a proposal to him which he accepted. We met one evening about the first of May in a railroad station in Chicago where we immediately took train for the west. I can never forget that first evening during which we became acquainted and talked over plans for the summer. Although I had then been some five or six years on the regular staff of the Biological Survey, and although he half-jokingly and self-deprecatingly referred to me as a "professional," we were about of an age, and the rate at which we found common ground on all sorts of subjects has scarcely ever been equalled in my experience. Evidently he did not find me larger nor more muscular than anticipated and I particularly remember the droll but emphatic way in which he expressed himself as I led the way from the dining car to the comfortable smoking coach. "You're the first Biological Survey man I've seen," he said, "who didn't act as if he thought I was a criminal every time I lit a cigar."

The Alaskan trip lasted five months, joint work being done mainly in mountains near Eagle and along the Yukon River from Eagle to Circle. Hollister also did independent work on the coast at Mitkof

Island and Kupreanof Island, Alaska and at Steilacoom and San Juan Island, Washington. One of the mammals obtained at the last locality was named for him, *Peromyscus maniculatus hollisteri*. Throughout the trip, he impressed me more for all-around balanced qualities than for outstanding ones. The broad fact about him was the all-embracing character of his love of animals and nature. Down to the meanest detail of work, there was nothing connected with the observation and study of animals, alive or dead, which did not partake of this love. Each phase of the subject was to him only part of one whole, none of which was to be slighted. The excitement of the chase and the exultation of capture or discovery held great charms for him, but the laborious paring of hides and other supposed drudgery seemed to give him no less pleasure. He did such things not only with good cheer but with an obvious enjoyment that was related not to the work itself but to its object. The finished specimen was to him something to be treated almost as if sacred. I have never known a man who, without being meticulous, took such pride in the quality of his specimens and such care of them subsequent to preparation. He evinced the same joy and maintained similar high standards in method and practice in making field notes, in keeping catalogues or records and in publishing results.

To his qualities as a collector and observer was added a charming disposition in which modesty, simplicity, loyalty and good humor were the leading features. An amusing incident never escaped him nor ever left his memory, so no one was long in his company without being entertained by a dry comment or a humorous anecdote. As a field companion, he was delightful and his equal will very rarely be found. He loved human beings, as such, regardless of appearances or station, and in traveling made friends among all classes with an unerring instinct for those with sound fundamental virtues. He was passionately fond of dogs and the only regret he ever expressed in connection with long field trips was that he could not take his dog. His favorite dog was a pedigreed English Setter, "Chick Stanton," which he had raised from a pup and trained for hunting and field trials. During the long field season when I was intimately associated with him, nothing impressed me more than his love for this dog. When other subjects failed, he was always ready to talk about dogs and, at times, it seemed as if he loved "Chick Stanton" more than mother, brother or any human being. That he had a sterner side, strong convictions on many subjects and great determination, however, was evidenced in many ways. As a good instance, a misfortune which befell him when he first began collecting

mammals in Delavan may be cited. While he was skinning a slightly decomposed skunk, one of his fingers became infected and a bad case of blood-poisoning set in. The whole arm was soon affected, discolored, and menacing in appearance to such an extent as to have caused panic in a man not endowed with nerve and determination. The local doctors, fearing the possible loss of his life, decided that amputation of the arm at the shoulder was the only safe course. When this information was given to the patient, he told them that his ambition to be a one-armed man was absolutely nil and that rather than permit them to operate he would take the small chance of life which they offered as the alternative.

On returning from Alaska in October, 1903, he again went to Delavan and again worked with his father in the store, but a few months later accepted another special detail from February 7 to April 10, 1904, as the representative of the Biological Survey on a hunting trip to Louisiana in company with Mr. W. E. Forbes of Boston and the well known guide B. V. Lilly. In June of the same year he was appointed to the field staff of the Biological Survey and, with the exception of a short furlough in the spring of 1906, was continuously employed in the field or in Washington until 1910. During this period he made two long field trips. The first began in Promontory, Utah, June 5, 1904, and ended at Magdalena, New Mexico, October 25, 1905. It covered some forty localities in the states of California, Oregon, Nevada, Arizona and Utah. The second lasted from May 6 to November 2, 1909 and was entirely in California. His collections for the Biological Survey reached a total of 3625 mammals and 1509 birds.

It was not until midyear in 1906, after his long trip in the west and his subsequent furlough, that he found himself in Washington, authorized to do something for the Biological Survey other than field work. His genius in the museum was immediately recognized and he was placed in charge of the care and arrangement of the huge mammal collection brought together by the Survey. To this task he brought all the enthusiasm and devotion he had given to his own collection in Delavan. Results were soon apparent, and there was no doubt among older heads that in Ned Hollister the Biological Survey had a "find." At the age of thirty, largely self taught, and having an experience mainly of field work, he began to delve into the literature of mammalogy and to show a capacity for straight thinking on matters relating to classification and nomenclature that was surprising. It was simply a part of his great love for the entire subject and, like the rest of it, he did it thoroughly and well.

On April 15, 1908, he was married to Miss Mabel Pfrimmer of Kentland, Indiana. A house was bought in Washington and books and other personal property were moved from Delavan. After a long series of temporary appointments and furloughs, he was settled with definite prospects of being able to pursue the study of the subjects upon which his heart was set. His wife brought a fine sympathy for his work and, especially by an extensive knowledge of modern languages, was able to be of material assistance to him.

Late in 1909, Hollister accepted an offer of the position of Assistant Curator of Mammals in the United States National Museum and took up his duties there January 3, 1910. Outwardly and aside from the slight increase in salary, the change may have appeared to some as mainly one of title, for at first, it merely meant moving into a new office and working on another collection housed in the same building. But the difference was a very great one to him, for if ever there was a man who belonged in a museum and nowhere else, it was Ned Hollister. From the days when the "Hollister Brothers' Museum" grew from a single cowbird's egg to the full occupancy of two rooms in the Delavan home, nothing was more evident than his passion for all phases of museum work. His first task in the National Museum was a staggering one, but he went to it single-handed as blithesomely as a school boy sent to meet his father at the circus. The new building had just been completed and the mammal collection was moved to it in April, 1910. Mr. Miller, Curator of the Division of Mammals, was absent in Europe and, therefore, Hollister found himself with the entire responsibility for moving, installing and rearranging the great reference collection. His own report of the first stages of the work, submitted to the Head Curator of Biology, July 1, and published in the Museum's Annual Report, is as follows:

> After the study skins were moved to the new building, late in April, work was at once begun on a thorough and careful systematic arrangement of the entire collection, so badly needed for many years. The Primates, Carnivora, Ungulata, Edentata, Marsupialia and Monotremata are now entirely arranged in the new cases in perfect systematic order, so that any particular specimen, or all of the specimens of a given group, can be found at a moment's notice. It is now possible to ascertain, in a short time, just what specimens the museum possesses in any genus of these groups, and what material would be desirable to build up and fill out the collection at its weak points.

How much this means can only be appreciated by those familiar with the conditions under which the collection had been kept for years in

the old National Museum building where some 70,000 specimens had been crowded into space scarcely sufficient for one-fourth that number. The work so well begun was continued until all groups were covered and for the first time in the memory of anyone now living the mammal collection of the National Museum was organized and systematized as a mammal collection should be. The great series of skeletons and the very numerous skulls of large size unaccompanied by skins also were overhauled as well as the bulky and very valuable cetacean material so well represented in the collection. Nothing was slighted, but even Hollister could not stay on such a task continuously, for there was so much of interest to be done in other ways. So, with Mr. Miller's encouragement, he seized all opportunities to enter into the study of exotic mammals, a subject which was new and very attractive to him. In this way, in a few years, he familiarized himself, so far as they were represented in the Museum, with the mammal faunas of tropical America, the Philippine Islands, Celebes, China, Siberia and eastern Africa. He published numerous papers covering a wide range of subjects and soon became recognized as one from whom sound, carefully considered contributions were to be expected.

He continued in this way for nearly seven years, only interrupted by two important field trips in 1911 and 1912. The first of these was to Jasper Park and the Mount Robson region of the Canadian Rockies, where he was in charge of the Museum party including J. H. Riley, C. D. Walcott, Jr., and H. H. Blagdon, acting in coöperation with the Alpine Club of Canada which afterwards published his detailed report. The second trip also was cooperative, being made in conjunction with Dr. Theodore Lyman of Boston and the Museum of Comparative Zoology. The objective was the Altai Mountains of Siberia, entailing a journey to St. Petersburg and thence across Russia and Siberia. Although the entire trip lasted only four months and bad weather conditions were encountered, an important collection of mammals was made, including thirteen new species and subspecies as well as many others theretofore unrepresented in any American museum.

Hollister's life, while directly connected with the National Museum, was one that appeared to satisfy him completely. So fascinated was he with the nature of his work and so engrossed in each problem encountered that he was accused of neglecting his friends and failing to enjoy the social advantages with which Washington abounded. Therefore, in November, 1916, when he was invited to become Superintendent of the National Zoological Park, which, like the National Museum,

is a subsidiary of the Smithsonian Institution, he perhaps accepted with some misgivings. Although by his transfer the Zoo gained a very competent officer, the Museum lost one of the most gifted and devoted curators who ever sat in one of its offices.

As Superintendent of the National Zoological Park from November, 1916, until the date of his death, he led a somewhat different life, still in Washington, still with many of the same personal associates, and still in touch with the National Museum, but with many executive and administrative responsibilities which deprived him of coveted time for study and research. His broad knowledge of animals and his genius for order and system were brought to bear on the problems of the Zoological Park with signal success. During his administration, the collection of living animals became larger and more varied than at any previous time. The attendance increased until it reached a total of 2,400,000 visitors in 1923. The grounds and animal quarters were improved in many ways. The deer and other ruminants were given increased space, and their yards, formerly much scattered, were brought together systematically to form an orderly and instructive series. One project in which he took much personal pleasure was the forming of a special collection of American waterfowl. A small pond, previously used for miscellaneous birds, was surrounded by enlarged space and made especially suitable for this purpose. The collection grew to contain some forty or fifty species and the conditions were so arranged that nearly one-fourth of them laid their eggs and hatched young annually. In presenting the needs of the Park to Congress, Hollister was also successful in years when appropriations for such purposes were very difficult to obtain. Largely through his efforts, a valuable frontage on an important street was purchased and added to the park area, thus insuring a highly desirable approach which doubtless will be greatly appreciated in future years. In his relations with the numerous employees of the Park, from gardeners, gatekeepers and policemen to office associates, he was exceptionally sympathetic and universally popular. Besides his annual report, which was prepared and published each year, he produced a popular illustrated guide to the animals in the Park which had a large sale, probably exceeding 30,000 copies.

Despite the distractions of his responsible position, Hollister still found time for research, probably in many cases by burning the midnight oil. His output of shorter papers continued at a somewhat reduced rate but was still varied in character. During his last years he was occupied chiefly with a large work involving much bibliographic

search and much handling of material. This was his *East African Mammals in the United States National Museum* which appeared in three volumes in 1918, 1919, and 1923, respectively. It was his most important contribution to mammalogy. Ostensibly a report on the East African collections made by Theodore Roosevelt, Paul Rainey and others, it was in reality a full résumé of the history, nomenclature, and relationships of one of the largest (probably the very largest) mammal faunas now existing. With the possible exception of his good wife, no one knows the amount of fidelity and care he devoted to this nor under what difficulties it was done.

His full bibliography is expected to be published by the Smithsonian Institution. It may be said here only that it comprises well over 150 titles, important among which are *The Birds of Wisconsin* (1903), *A Systematic Synopsis of the Muskrats* (1911), *Mammals of the Philippine Islands* (1911), *Mammals of the Alpine Club Expedition to Mount Robson* (1913), *Mammals Collected by the Smithsonian-Harvard Expedition to the Altai Mountains* (1913), *A Systematic Account of the Grasshopper Mice* (1914), and *East African Mammals in the United States National Museum* (1919–1923). In the course of his field work, he collected the type specimens of 26 mammals, and the new mammals named by him total 162.

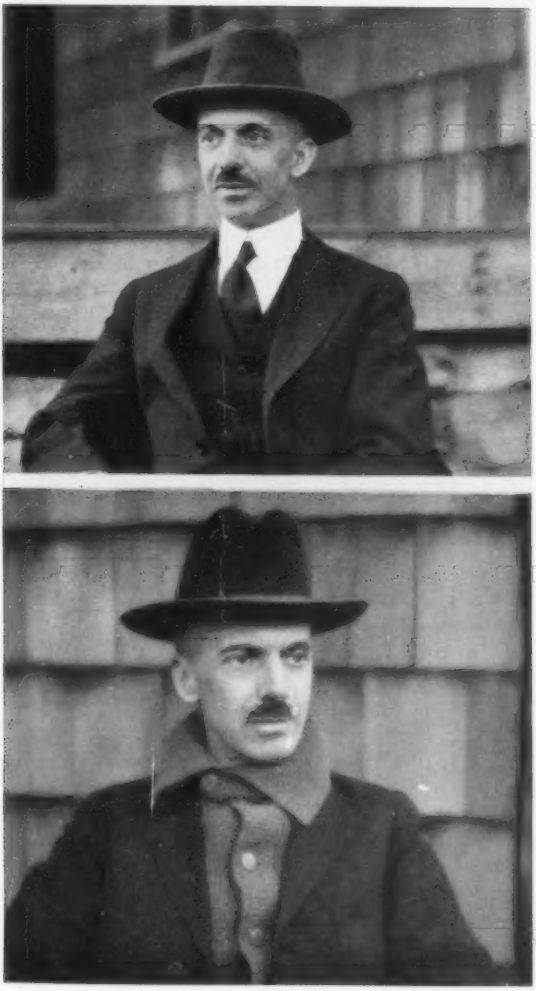
Mr. Hollister was a member of various scientific societies, many of which saw fit to honor him with office as well as to avail themselves of his most capable services. He was for a time an associate editor of the *Journal of the Washington Academy of Sciences*, having served his apprenticeship on the Publication Committee of the Biological Society of Washington. In 1921, the Biological Society elected him its President and his name was thus added to a roster of presidents including most of the leading zoologists and botanists who have lived in Washington during the past half century. He was one of the signers of the original call for the organization of the American Society of Mammalogists and one of the principal participants in its actual launching. At the first meeting in April, 1919, discussion quickly focussed on whether or not Hollister would or could find the time to serve gratuitously as editor of the JOURNAL. He would, and he could, and he did with such results as all of us have seen, in the faultlessly neat, accurate, and scholarly journal which he has produced for us for the critical period of the first five years of the Society's existence. That it was no small burden to him there can be no doubt. At a special meeting of the Directors of the Society held November 20, 1924, a brief memorial resolution was

adopted and it may be ventured that no board of directors ever passed a similar resolution in which the literal sentiments expressed were more keenly felt by every member. It is as follows:

In the death of Ned Hollister, charter member and editor of our JOURNAL since its establishment, the American Society of Mammalogists has sustained an irreparable loss. But most of all each of us mourns the departure of a warm personal friend. We shall long miss him for his congenial companionship, his ready helpfulness, his unvarying patience, his keen intellect, his scientific skill, his sterling worth. Therefore we, representatives of the Society, hereby record our deep grief in the loss of our friend and co-worker, and our keen appreciation of his rare qualities as a scientist and as a man; and we extend to his bereaved widow, his mother, his brothers and sister, our heartfelt sympathy in the greater sorrow which is theirs.

No further summary of his character and achievements seems necessary. A man loved, respected and honored has gone from a small company. It is, indeed, a very small company, for if we take stock of ourselves, we cannot but realize how few are the real students of mammals. The type represented by Ned Hollister is one which, under present economic and social conditions in this country, seems threatened with extinction while yet the need for it continues to be very great. Therefore, his passing before his time is the more to be regretted. We mourn a genial friend beloved for his attractive human qualities and we deplore the absence of a colleague of trained ability; but when we look for his like among the coming generation, we are brought to the distressing realisation that this is not all, for no one stands ready to fill the gap in the ranks.

Field Museum of Natural History, Chicago.



NED HOLLISTER

(Osgood: Ned Hollister)

THE HAIR PATTERN OF A KANGAROO; A STUDY OF CAUSE AND EFFECT

By Frederic Wood Jones

By ornithologists the work of Nitzseh (*Pterylographia;* 1833) is generally recognized as providing the basis on which a truly scientific study may be made of the feather covering of birds. Feather tracts must be described by anyone who wishes to give an adequate description of the external characters of a bird. The hair tracts of mammals have also been extensively studied, and at the present time a very voluminous literature has been accumulated upon the subject. But, as a general rule, I think it is fair to say that the mammalogist himself has not been greatly concerned with the hair tracts of the creatures in which he takes most interest. Many books, however, which deal with the marsupials contain some note upon the hair pattern of kangaroos, and in the British Museum Catalogue of Monotremes and Marsupials (1888) the hair tracts of kangaroos are mentioned among specific diagnostic features. For this reason, and in consequence of the fact that kangaroos are the animals of which I am able at present to command most material, I select a species of this group as an introduction to a newer study of hair tracts which may possibly be of interest to the mammalogist.

In order to study the hair tracts of any mammal to the best advantage, it is necessary to select the proper material. A well preserved young animal, at the stage when the hair is just beginning to make its appearance, and some adults living, as far as possible, in a state of nature are all that is required. The spirit-preserved young animal is needed for the recording of the actual hair patterns and hair trends; stuffed adult animals, or furred skins that have been through the hands of the taxidermist are apt to mislead the student. The adult live animals are needed, since after we have prepared the chart of the hair patterns from the study of the young, we must turn to them to explain the chart to us.

To many this will sound ridiculous; but, nevertheless, I sincerely hope that every mammalogist who has material and opportunity at his disposal will incorporate these two things in the routine study of every mammal available. In the present case I have prepared hair charts on scale drawings of a pouch embryo of a large wallaby (*Wallabia greyi* Gray, 1846). The chart shows two aspects of the animal, the right lateral (Fig. 1) and the dorsal (Fig. 2). It will be seen at once that the arrangement of the hair is extremely complicated; that there are partings and whorls, convergent hair lines, and complete reversals;

the free tips of the hair being directed sometimes towards the head, and sometimes towards the tail.

FIG. 1. HAIR TRACTS OF WALLABIA GREYI, POUCH-YOUNG
Right lateral aspect

In a primitive marsupial (such as *Dasycercus*), just as in a primitive monodelphian, the hair covering of the body is directed uniformly from head to tail, the free tips of the hairs pointing backwards and also down-

wards towards the ground. Areas in which the hair has this primitive slope may therefore be termed normal areas. It is at once apparent

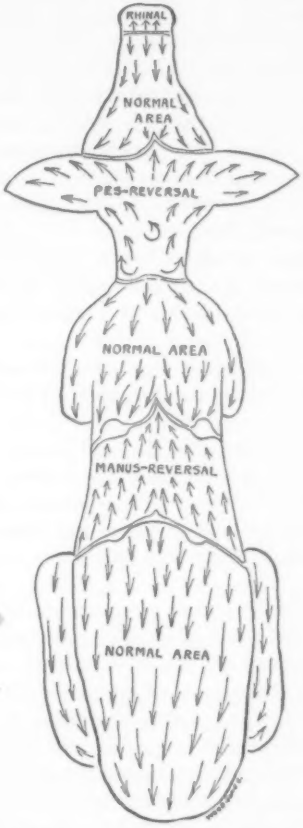


FIG. 2. HAIR TRACTS OF WALLABIA GREYI, POUCH-YOUNG
Dorsal aspect

that in the young wallaby there are several areas which are not normal, areas in which the primitive direction of the hair is wholly or partially reversed. The areas, as depicted in the figures, are disposed in the

following order: Starting from the nose, there is a small area of rhinal reversal just behind the opening of the nostrils. This abnormal area is followed by an area of normal hair trend which extends backwards as far as a line joining the anterior (upper) attachments of the ears. A converging hair line separates this normal area from the next (abnormal) field which takes its origin from a whorl on the occiput and radiates forwards on the neck and vertex of the head and outwards on the ears. Behind the occiput the reversed field is succeeded by another normal one, which extends over the shoulders and ends on the back just behind the line joining the two elbows. Across the back at this level there runs another convergent hair line, behind which is another abnormal field of reversal which stretches tailwards to the lower costal region, or a line passing round the body at about the level of the flexed knee. This reversed field is separated by a divergent hair line from the normally-sloped hair which clothes the lower dorsal, lumbar, sacral, and caudal regions.

Only one other main field of reversal need be noticed, and that is the ventral, perineal and lower abdominal area. This hair pattern, at first sight, seems to be extremely complex and to be inexplicable on any grounds of utility or of functional demands. But the next step in the inquiry is to take the chart and patiently observe the actions of a living animal of the same, or a nearly allied, species (it must be remembered that the hair tracts of all kangaroos are not identical). A very little watching will solve the problem of the causation of one or other of these tracts.

The toilet of the coat is an enterprise which bulks large in the activities of kangaroos and wallabies. They can scratch their fur with their hands and they can scratch it with their feet. Their feet are even armed with one of the most remarkable of mammalian hair combs in the form of the syndactylous second and third pedal digits.

If an animal scratches and combs its fur in the direction of the primitive hair trend it is not to be expected that any change in hair disposition will result. But if it habitually scratches and combs it the wrong way, it will in the end produce, so I contend, those reversals with which we are familiar.

When a kangaroo scratches itself with its foot, the combing affects the area of the occipital whorl, and from there combs the hair forwards and not backwards. This abnormal tract I, therefore, term the *pes-reversal area*. When the hand scratches the hind end of the body it also tends to comb the hair forwards and the short-armed, long-bodied,

kangaroo reverses the abnormal area of the mid-dorsal region. This abnormal tract I, therefore, term the *manus-reversal area*. But the hands can also reach the ventral surface of the hind end of the body and, in scratching the fur there, they also comb it the wrong way. In this manner is produced the abdominal manus-reversal area.

Now these are not speculative statements. Anyone may readily convince himself of the part played by a kangaroo in reversing the trend of his own coat by his oft-repeated toilet operations. I suggest that a proper study of the toilet of the coat in any mammal will solve the question of the causation of most of the hair tracts present on the animal. The scratching with manus and pes does not exhaust the methods employed in the mammalian toilet. We have to reckon on the part played by the tongue, by the teeth, and by the horns in different mammalian types. For a demonstration of the part played by the teeth, the lemurs form an interesting study; for the part played by the tongue, the cats may be watched. The roughness of the feline tongue is probably far more a toilet, than an alimentary, adaptation; and the part played by the tongue in producing the rhinal reversed tract in mammals seems never to have been realised. It is possible that the tongue may be responsible for more than the rhinal reversal, and the curious groin reversed tract in the horses may be correlated with upward licking. I hope that those mammalogists who have opportunity will extend this study of a correlation of hair tracts and toilet habits, by patiently observing the methods employed by different mammalian types.

Now though I am convinced as to the method of causation of the main hair pattern of those marsupials with which I have become familiar, this very simple explanation involves some very far-reaching consequences.

The immature pouch-young of a kangaroo begins to develop hair. As soon as the hair appears it is arranged in a highly complicated pattern of whorls and partings, convergences and reversals. This complicated pattern is accounted for by the trivial toilet methods of the adult. It is not the outcome of profound change, it is not the result of profound need, it is not a result which achieves great utility in the economy of the animal. Yet long before the pouch embryo has need to scratch itself, its coat bears the impress of the scratching done in the idle moments of its ancestors. If this is not a true Lamarckian inheritance of acquired characters it is difficult to conceive what is.

University of Adelaide, South Australia.

HOW SQUIRRELS AND OTHER RODENTS CARRY THEIR YOUNG

By Herbert Lang

[*Plate 3*]

On learning of my interest in African squirrels, Dr. Lillian D. Powers, kindly invited me to make several visits to Elmsford, White Plains, New York. Far out in a beautiful, quiet stretch of country, nestling among stately groves of trees, lies her experimental station for the study of the behavior of squirrels. About two-thirds of a large three-story dwelling has been transformed into ideal squirrel homes.

For several decades here and abroad she has assembled Sciuridæ of different continents. Under her watchful care numerous generations of squirrels have been raised. That this solicitude is not wasted makes itself apparent to even the most casual visitor. Far from being disturbed when their guardian enters the quarters, the squirrels rather offer a cheery welcome. Some even respond when called by name. Their remarkable vivacity and unconcerned performance of never-ending tricks and pranks among themselves is a guarantee that they feel no burden of confinement. Spotless cleanliness and absence of any odor are as noticeable as the fact that these furry inhabitants hardly ever damage the woodwork by gnawing. Young shoots sheathed with bark, a great variety of food, and other means of satisfying their desires are provided.

Lately Doctor Powers succeeded in taking an unusually interesting film showing certain phases of the life history of some of these squirrels. Among the many details recorded in this fascinating display are some showing how a mother squirrel carried back to the nest, one by one, her young which had been removed for the purpose of observing that very thing.

Ever alert as to the welfare of her offspring, the female shows a great deal of nervousness when danger threatens. Through her care they often escape untimely death and thus are preserved to their race in numbers. Bravely she assumes the task of transporting them out of harm's reach. The process is as simple as efficient. Of necessity, the little ones must do their share.

With a few notes of warning the frightened mother seems to arouse the youngsters to a readiness for the emergency. Certain it is that as she picks up one it instantly tries to make the fullest use of the clinging

propensities of its limbs. With her incisors she takes firm hold of its skin on the ventral surface or the proximal parts of the limbs. Without a moment's delay the tiny fore and hind limbs are placed about her neck or in such a position as to secure a satisfactory purchase. To make a well balanced load as close to the mother's neck as possible is the aim. The tail of the offspring also is tucked out of harm's way, by being bent up over the parent's back. This particular manner of holding the young undoubtedly had its origin in securing to them the greatest amount of safety and convenience. In the wild state their successful removal depends as much on unimpeded progress as on speedy action.

Nothing could illustrate this better than the accompanying photographs, which present some excerpts from the moving picture film. Here a female of the Central American squirrel *Sciurus hoffmanni* appears in three typical poses while carrying off her young. In the upper picture she has just lifted it up by the skin of the ventral surface. So rapid has been the movement of her forearm in arranging the load that the moving picture camera was not quick enough to define it sharply. The lengthened and distorted toes, trying to adjust the position of the head of the young, are the result. The center photograph shows her ready to start off. The young one's head is tucked upon the mother's breast; the left ear in view. The lower picture gives a good idea of the nicely balanced position of the young, held near the flanks between the incisors of the mother, with limbs encircling her neck, and tail passed over her shoulder and back.

The Powers photographs show beyond doubt that at least one of the Central American squirrels does hold its young somewhere about the underside or the flanks, and not by the nape of the neck. Furthermore all squirrels which have come under the observation of Doctor Powers during many years of experience carry their young in the same fashion. This includes also the European squirrel *Sciurus vulgaris*.

Similar instances for the American gray squirrel *Sciurus carolinensis leucotis* (Gapper) corroborate this habit. Dr. Glover M. Allen, of the Museum of Comparative Zoölogy at Cambridge, has seen one of them "carrying a very small young one by the loose skin of the belly, so that the head and tail of the young squirrel curled back on either side of the parent's head."

Also Mr. T. Donald Carter, of the American Museum of Natural History, tells me he saw one of our gray squirrels, a female, in New Jersey, making three trips transporting her nearly half-grown offspring

in this way from her arboreal nest to the eaves of a barn, each time covering a distance of about 150 yards.

In Central Park, New York City, Mr. S. H. Chubb, also of the American Museum, watched a gray squirrel in the month of May moving its young in the same manner. Though not able to ascertain positively where on the under side of the body the young was held, he did notice that the little one apparently tried to lessen the burden by gripping the mother's neck with its limbs, one of the fore feet clutching her ear.

A while ago Mr. L. L. Snyder (1923) recorded his observation made in High Park, Toronto, when a black squirrel *Sciurus carolinensis leucotis* (Gapper) transferred its young from one nest to another. In view of the above, however, the pose taken by the young, as shown in his sketch, seems to be an improbable one. Certainly, as he says, the "young aids the parent by encircling its hind legs about the neck of the latter," but Mr. Snyder's drawing gives the impression that the little squirrel was held at the back of the neck by the mother and its entire body twisted to her left side. A squirrel's neck would seem to be too short to assume such a pose. Vague also is Ingersoll's statement (p. 548) about the gray squirrels to the effect that "sometimes the mother transports her kittens when blind and hairless carrying them in her teeth."

In view of the facts previously cited the following quotation from Harting (p. 102) by Millais (Vol. II, p. 156) is rather surprising. "The old Squirrels [*Sciurus vulgaris*] in case of danger . . . carry them [the young] one by one in the mouth, just like a cat carries her kitten." Domestic cats and dogs can readily be induced to furnish an illustration of such procedure. Indeed it has become a matter of common knowledge that carnivora carry their young about in the mouth. With the incisors they take hold of the loose, thick skin on the back of the neck, not of the under side or back, as certain rodents do. The only exception I ever heard of refers to a polar bear in the London Zoological Gardens that was noticed carrying her cub, not in her mouth, but tucked under her arm (Mitchell, p. 168).

Dr. G. Clyde Fisher kindly called my attention to a photograph in the files of the American Museum of Natural History taken by Mr. William H. Fisher of Baltimore in which the American flying squirrel *Glaucomys v. volans* (Linnæus) is trying to pick up its very tiny young by the skin just back of the shoulder. In a recent letter about this Mr. W. H. Fisher says that first "she gathered it up in a bunch with her front paws." The squirrels "were in a low stump which was broken

open, exposing four young. The old one hung around for a few minutes, watching, and then carried her young in the mouth, one at a time, running across the ground to another tree about 50 feet away, up which she took them to a hole of some kind about 30 feet high."

If, however, young squirrels are too small to make satisfactory use of the grasping power of their limbs while being carried, means to suit natural conditions are resorted to. That this is not merely the case in captive specimens is vouched for by Mr. George K. Cherrie. Some years ago when he was hunting fox squirrels *Sciurus* (*Guerlinguetus*) *niger rufiventer* (Geoffroy) at Knoxville, Iowa, a female, alarmed by the shots, rushed out of a nearby nest. Three very small young clung firmly to her mammæ. While this might be explained as a case of fright, where the mother did not even stop to remove her suckling young, they, nevertheless, left thus to their sensory response to clamber, succeeded in safeguarding themselves in this way.

The same practice is common among the Muridæ. An entire litter when tiny is often transported for some distance by firmly adhering to the mammæ. It would be interesting to verify Gerbe's interpretation of his observations. According to him the mother is able to urge all her young ones to fasten themselves rapidly to her in this manner. This is as remarkable as his statement of their maintaining a hold even when dragged on the ground. Those however which let go are later taken up and carried off one by one in her teeth, although there seems to be considerable variety as to what part of them is held between her incisors. Gerbe (p. 605) in his extensive article on the life history of *Microtus incertus* (de Sélys-Longchamps) describes the procedure as follows:

> Still too weak, they would be unable to escape, if the mother, whose vigilance and solicitude are excessive, did not come to their assistance. She arrives indeed in a hurry, sits upon them, and presently makes certain peculiar motions which probably are an indication of the imminence of danger, for at this signal, the young seize her mammæ in their mouths and attach themselves to them in some way. Thus welded to their mother, they let themselves be dragged by her far from the nest without making a movement. When the danger has disappeared she brings them back in the same manner; and if it happens that one of them drops off the mammæ she looks for it and brings it back between her lips.

Lataste recorded (p. 208) that the female of a captive pair of *Meriones shawi* Duvernoy when disturbed carried away her three young attached to her mammæ. Yet he doubts (p. 245) whether this is done deliberately.

He rather believes that to remove the young from the spot of danger "the Rodents, *Meriones* or others, use exclusively the mouth and take hold of their young by the skin of the back." Two actual observations (p. 351) of *Mus decumanus* Pallas bear out the truth of his statement, at least for this species. Later (p. 397) he adds that "when the mother sometimes leaves the nest rapidly, she drags away the young attached to her mammæ, and they do not fail to drop off." The mother then returns and "taking them with the mouth" replaces them in the nest.

Among fossorial rodents there is probably no need for the sudden transfer of the young by the parents into other quarters; but data on this subject are apparently scarce.

As in the swiftly moving ruminants, so in cursorial rodents, like the agouti *Dasyprocta*, the young immediately after birth follow their mother with great ease and vivacity, not rarely going a considerable distance from her, but returning at once when they hear her growling call (Schmidt). No assistance in transporting them would be needed yet in exceptional cases the female also takes hold of her young. In captivity the male often develops cannibalism and becomes a source of perturbation for the female. Bodinus records of such an instance that whenever the young came too close to the male, the mother, with hairs raised, would rush after them, and holding them in her mouth carry them back in a safe corner.

In an aquatic form like the beaver (*Castor*) the "eyes of the young are open from the beginning, and in less than two weeks they appear in the water accompanied by the mother" (Mills, p. 27). Also in the South American coypu (*Myocastor*) the young are very soon able to follow the mother to the water, some readily climb on her back, and are carried about as she swims, while others join alongside (Mitchell, p. 178).

Recently Mr. Warren (pp. 202–203) reports having seen at Monument Valley Park, Colorado Springs, a muskrat, *Ondatra zibethica pallida*, transferring one by one her young from the nest at the edge of a pond to a place on one of the nearby islands. Within an hour in the late afternoon she made seven such trips of about two minutes each. The young, about the size of a large field mouse, were held in her mouth apparently by the skin of the belly. The parent "swam with her head quite high out of the water, presumably to keep the youngster from drowning, and at the same time the posterior third, and I think oftentimes half, of the tail was elevated above the water, literally waving in the air." When returning unburdened for another young the muskrat swam in the usual manner with the tail submerged.

Among the Lagomorpha actual data on this subject appear to be scanty. Unlike the helpless litter of the rabbit, born in a more or less sheltered retreat, the young hare enjoys at once a certain independence and is able to escape danger by flight (Pycraft, p. 9). That in certain measure they are able to look out for themselves from the start is also shown by Landois' observation (pp. 18-19) in the zoological gardens in Münster in the case of the European hare (*Lepus europæus*). The mother made no provisions for a nest such as rabbits habitually prepare or for a "form" such as many hares are known to arrange in or about clumps of vegetation. Immediately after its birth, when the mother had licked the young one all over, it walked about, following her closely wherever she went. During the daytime the little hares remain in hiding in places different from the one used by the mother, because of the hazards the life in the open entails. Only in the evening do they venture forth and join the family party. At the slightest approach of danger they at once try to conceal themselves and keep "planted." In this, the young may be directed by the adult who perhaps assures them when the trouble is past. There is no carrying of the young by the parent.

Here, too, statements to the contrary are found in the literature. Millais (III, p. 13) cites the Rev. E. A. Peacock as authority that "they are carried as a cat carries her kittens." Tregarthen (p. 13) goes still more into detail: "Seizing him [the young] by the skin of the neck she bore him rapidly along despite his kicking." The tender, thinly haired rear part of a hare's neck is the most unlikely place to be held between the incisors, were it to be carried at all.

In the wild state most rodents are so evasive and fleet as to make accurate observation of certain points in their life history often difficult. The more so with regard to what one might consider the tragic moments in the mother's solicitude for her young. In captivity, however, they obviously admit to the family circle those trusted friends habitually engaged in rearing them. Thus favored, the gathering of definite data becomes easier and, once known, can be checked up on wild creatures. In this particular instance the photographs of a squirrel carrying its young in the mouth (plate 3) furnish such convincing details that Doctor Powers is to be heartily congratulated for her patience, skill and success in obtaining these records with the moving picture machine.

BIBLIOGRAPHY

GERBE, Z. 1854. Observations pour servir à l'histoire de l'*Arvicola incertus* de Selys. Rev. et. Mag. Zool., (ser. 2), vol. 6, pp. 595–608.

HARTING, J. E. 1891. Hybernation of Squirrels. The Zoologist, (ser. 3), vol. 15, pp. 101–102.

INGERSOLL, ERNEST. 1892. Our Gray Squirrels: A Study. Harper's New Monthly Magazine, vol. 84, pp. 544–550, 4 text figs.

ISPOLATOV, E. 1907. Wie das Eichhörnchen seine Jungen fortträgt. Jestestv. i geogr., Moskva, vol. 12, 10, pp. 66–67. (Not seen.)

LANDOIS, H. 1884. 12th Jahresber. Westfälischer Provinzial-Vereins, Münster, pp. 18–19.

LATASTE, FERNAND. 1887. Notes prises au jour le jour sur différentes espèces de l'ordre des Rongeurs observées en captivité. Actes Soc. Linn. Bordeaux, (ser. 5), vol. 1, pp. 201–536.

MILLAIS, J. G. 1905–1906. The Mammals of Great Britain and Ireland. Longmans, Green, and Co. 3 vols.

MILLS, ENOS A. 1913. In Beaver World. Houghton Mifflin Co. New York.

MITCHELL, P. CHALMERS. 1912. The Childhood of Animals. London. William Heinemann.

PYCRAFT, W. P. No date (1913?). The Infancy of Animals. London. Hutchinson and Co.

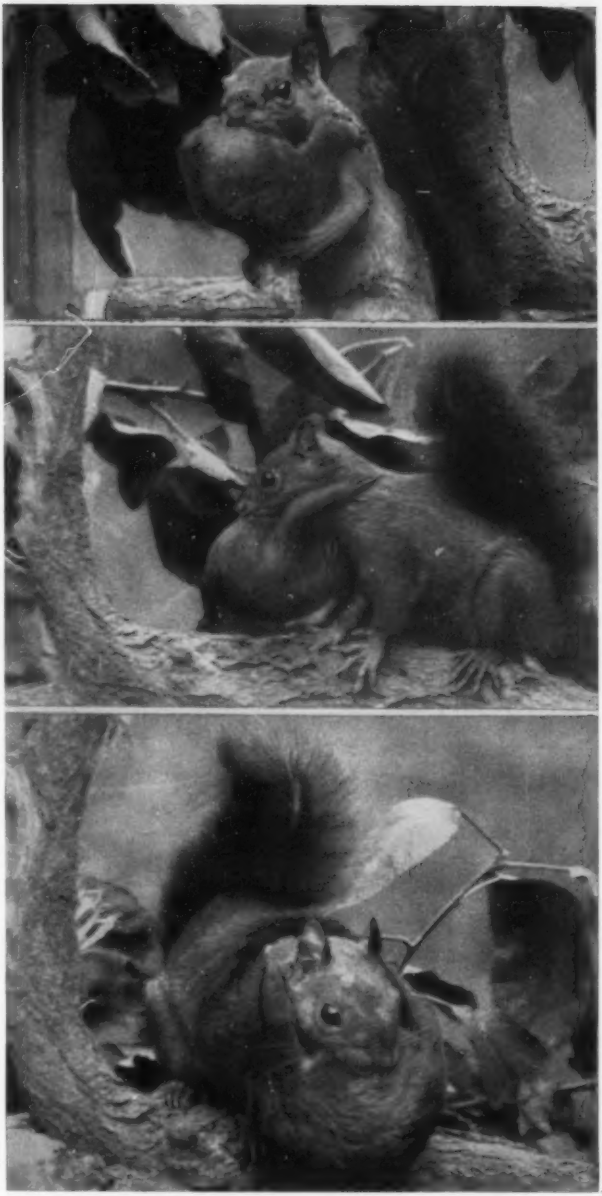
SCHMIDT, MAX. 1864. Zool. Garten, Frankfurt am Main, vol. 5, p. 406.

SNYDER, L. L. 1923. A Method Employed by a Black Squirrel in Carrying Its Young. Journ. Mammalogy, vol. 4, p. 59, text fig.

TREGARTHEN, J. C. 1915. The Story of a Hare. New York. Hearst's International Library Co.

WARREN, EDWARD R. 1924. A Muskrat Moves its Young. Journ. of Mammalogy, vol. 5, pp. 202-203.

American Museum of Natural History, New York.



CENTRAL AMERICAN SQUIRREL (SCIURUS HOFFMANNI)

Photographs enlarged from moving picture film made by Dr. Lillian D. Powers at "Red Squirrel Farm," White Plains, N. Y.

(Lang: How squirrels and other rodents carry their young)

THE SCIENTIFIC VALUE OF PREDATORY MAMMALS

By Lee R. Dice

Recently it has come to my attention that the Michigan Department of Conservation together with the United States Bureau of Biological Survey has set out to exterminate the wolf, coyote, and several other species of predatory mammals in the State of Michigan. Such an ambition, which I believe extends to other states, if realized, seems sure to be detrimental to science as well as to several other phases of human endeavor. It therefore seems worth while to consider briefly the extent of the scientific value of predatory mammals.

From a scientific point of view predatory mammals have equally as great importance as non-predatory forms. Indeed, it would be very difficult, if not impossible, to demonstrate that any one kind of animal has a greater scientific value than any other kind.

Any species of animal which is the sole living representative of its group is of great scientific importance as being a unique type. On the other hand, all the species and subspecies which together constitute a series of closely related forms are also of high scientific value, for, by the critical study of such groups of closely related forms, we can secure important evidence about the process of organic evolution and about the factors concerned in causing evolution.

Every kind of mammal, as well as every other kind of organic being is of great scientific significance, and the world can ill afford to permit the extermination of any species or subspecies.

Progress in all branches of zoology is dependent upon the study of living forms, and our knowledge of no species nor subspecies is sufficiently complete to assume that it is no longer needed for scientific observation. There is no substitute in scientific work for the living animal and the fresh specimen, and every species exterminated marks a decided loss for the scientific world.

Comparative anatomy and embryology are of necessity dependent upon a supply of specimens of living forms of animals, and, although a few specimens may be preserved for a time in alcohol or otherwise in our museums, yet we cannot anticipate our future needs and preserve as many specimens as we shall require in the future, even if space and finances would permit. Neither can these museum specimens be expected always to be suitable for the uses which the scientist of the future shall require. Published descriptions of the anatomy and the embryology of species which have been exterminated are of course of

much use, but such descriptions are always open to suspicion if original specimens are not available for comparison; and further, the very best descriptions of this age may be hopelessly inadequate in the not distant future.

In comparative anatomy and embryology we must, if our work is to be complete, consider not alone each generic group, or even each group of closely related species and subspecies, but we must consider each individual subspecies. In anatomy and embryology such fine distinctions have, it is true, not usually been made; but enough has been done to demonstrate that the characters which distinguish the subspecies and species of mammals are not confined alone to the skin and the skull, but appear, when we search for them, in all parts of the body. All these characters have an ultimate bearing on our elucidation of the facts of evolution, and the loss of any subspecies will make more difficult, or perhaps impossible, a correct interpretation of the evidence presented by that series of forms.

As a matter of fact, our knowledge of neither anatomy, embryology, histology, nor cytology of any North American species of mammal can be considered complete at the present time, and, indeed, only for a few species is our knowledge more than fragmentary. Further, our knowledge of the comparative physiology of the native North American species is still more meagre. All this applies to predatory as well as to non-predatory forms.

Paleontology, which furnishes the most important evidence as to the phylogeny of the various groups of animals, could be but little developed were we unable to compare the fossil specimens with similar anatomical parts in related living species, and if we did not know the amount of individual variation in the group as shown by the living relatives.

Students of geographical distribution will agree that our knowledge of the native distribution of North American mammals is far from complete. The inroads of civilization have deplorably altered the distribution of many forms. Many of these changes have undoubtedly been unavoidable, but every effort should be made to keep our native animals in a state as nearly natural as possible. Only by the critical comparison of animal distribution, based on accurate knowledge, with the various environmental conditions of the continent, can the controlling factors in animal distribution ever be satisfactorily determined.

The habits and life-histories of none of our native mammals are fully known, and for most of our species, even the commonest ones, our

knowledge is deplorably meagre. Little attention has so far been given to the differences in habits between closely related forms or in the same form in different parts of its range, although these differences have an important bearing on the evolution of the group.

The lives of all species of animals living in one locality are closely interrelated; especially close are the relations between the carnivores and the forms on which they prey. All of these associated forms, predatory and non-predatory alike, have evolved under mutual adjustment, and all of these associates must be considered together in any attempt to explain evolution or distribution. With the predatory mammals eliminated it will become more difficult to explain the origin of many adaptive structures and habits in the remaining species.

The explanation of the facts of evolution and of distribution are among the most fundamental problems of biology, and for their solution we shall need the greatest possible completeness of knowledge about all possible kinds of animals. The world, therefore, cannot afford to permit the elimination of any form of wild life without the most urgent economic reasons, as determined by the most careful investigation.

I do not advocate that predatory mammals be encouraged nor permitted to breed everywhere without restriction; but I am sure that the extermination of any species, predatory or not, in any faunal district, is a serious loss to science.

University of Michigan, Ann Arbor, Mich.

THE PREDATORY MAMMAL PROBLEM AND THE BALANCE OF NATURE

By E. A. Goldman

The treatment that should be accorded certain of the larger predatory mammals—whether their depredations should be tolerated, or whether extermination in certain areas should become a fixed policy—is a problem concerning which there is some difference of opinion. This problem is intimately bound up with complex relationships existing in nature, some of which must receive consideration in order that the problem in its true bearings can properly be understood.

Under normal primeval conditions there is a tendency everywhere to establish a nearly balanced status through a continuous process of readjustment in the contacts existing between species. This somewhat hypothetical condition is commonly referred to as the balance of nature, the biological balance, or the climax association. By it is meant that through competition in the struggle for existence a point has been approached where none of the species in a given area is increasing or decreasing in number of individuals. In this conception animals and plants are closely associated, and both kingdoms therefore are included within its scope. Each species has certain imperfectly known environmental requirements, or meets pressure from other species which under normal conditions definitely limit its numbers and fix its geographic distribution.

Some of the factors preventing expansion beyond the borders of definite areas may be physical barriers, improper temperatures, too much or too little moisture, or (for animals) lack of suitable vegetable food or other animals upon which to prey, or the species may itself be preyed upon to a degree that renders its existence impossible beyond certain limits. Many species when fortuitously or through human agency purposely introduced into new areas not formerly accessible, as, for example rabbits and cacti in Australia, mongooses and English sparrows in America, may multiply amazingly owing to abundance of food, absence of natural enemies, or other favoring conditions. The effect of such introductions on native species is often disastrous because of the new competition that must be met, and a new alignment of relationships ensues. Leaving man out of the setting as a disturbing factor, natural causes, such as fire, drought, and floods, epizootics, or conditions temporarily favoring the expansion of certain species at the expense of others, frequently upset the local balance, which

swings back, however, through readjustments, to the normal for the general area.

At the time of the discovery of North America, the general range of countless numbers of large game animals, such as buffalo and elk, was measured by nearly the full width of the continent, and innumerable antelope roamed the western grassland plains from Alberta and Saskatchewan to northern Mexico. Deer were plentiful, while moose and caribou, mountain sheep, and bears in large numbers occupied vast areas from which they have now disappeared. The larger carnivores, mountain lions, lynxes, bobcats, wolves, and on the western plains, coyotes, followed and preyed upon the game herds, and the surplus afforded food for great numbers. Primitive human tribes armed with bows and arrows existed largely as so many predatory animals, with comparatively slight effect, except locally, on the general balance at that time prevailing.

But with the occupation of the continent by Europeans bearing firearms, clearing the forests, and settling permanently throughout its extent, the balance of nature has been violently overturned, never to be reëstablished; and the violence of the overturn has been usually in direct ratio to the density of this new human population. From the early settlements, largely near the Atlantic coast, intensive occupation of the country has spread gradually westward until it now embraces nearly all of the more favorable sections as far as the Pacific littoral. The profound changes brought about by man in his progressive encroachment on the haunts of the larger game, especially along with his too indiscriminate use of modern firearms, have led to the disappearance of most species over much of their former range. Those that remain have been forced to seek the more inaccessible regions, especially the mountains, in the west, fortunately, now largely within the national forests and national parks.

The large predatory mammals—mountain lions and wolves—require for proper sustenance animal food in large quantities. Owing to this compelling need, coupled with abundant power to kill, their preference is for large game, and in their normal diet small animals such as rodents and birds form an inconsiderable part. In order, therefore, to procure accustomed food they have followed the retreating game, or where this is gone and they have been permitted to exist, have turned their attention to the livestock of the settlers. Where numbers of these roving animals are uncontrolled the overturning of the balance that formerly existed tends to concentrate their onslaughts

on the already numerically reduced game, threatening its extermination; and unrestrained attacks on livestock have rendered some sections wholly unremunerative as grazing areas. Some idea of the magnitude of the damage to livestock by predatory mammals in western States may be gained from the estimate of $20,000,000 annually, based on extended study and observation of conditions at the time systematic work directed toward the control of these animals was undertaken by Federal and State organizations in 1915.

Coyotes have in recent years been a very serious menace to the human population, as well as to livestock, through the alarming spread of rabies over several western states. The malady began in central California in 1909, and by 1915 had extended over northern California and much of Oregon, Washington, Idaho, and Nevada. The recorded number of people bitten by November 30, 1923, is over 2000, of which there were 56 deaths. The prompt application of the Pasteur treatment doubtless saved hundreds of lives. In 1915 and 1916 the losses of livestock from rabid coyotes in Nevada alone were estimated at $500,000. Four hundred head of cattle were reported to have been killed on one ranch. In January, 1922, a new outbreak in Washington was stopped by the concentrated coöperative efforts of Federal, State, and County officials, when 1800 coyotes had been killed in four counties. In 1923 sporadic outbreaks were suppressed in California, Oregon, Nevada, Utah, Idaho, and Washington, and in the same year the disease appeared in coyotes and bobcats in Colorado, where, within a short time, four persons were bitten, and livestock valued at $4000 was destroyed.

It has been asserted by some that predatory mammals exert a beneficial influence in preying upon rodents, thus preventing their abnormal increase and maintaining the natural balance. It is true, of course, that the smaller carnivores, including the valuable fur bearers we wish in general to protect, feed extensively upon rodents and thus tend to reduce their potential rate of increase; but there is much evidence that two other important factors limit the number of many rodents. These are, and always have been, the available food supply and epizootic diseases. It is a well established fact that many rodents tend to increase in numbers locally until visited by periodic outbreaks of disease, which may leave only a few individuals where thousands had previously existed.

If the food supply is abundant many rodents multiply amazingly in spite of the inroads of predatory mammals. This was well shown

in an instance that came under my observation in the southern part of the San Joaquin Valley in California 35 years ago, when the country was still for the most part unsettled. No serious efforts had been made to reduce the number of predatory animals and they were present in apparently normal numbers. Jack rabbits, however, were so excessively abundant and became so troublesome to the scattered farmers that concerted action was necessary to afford relief. Numerous rabbit "drives" were organized in which several hundred men, women, and children, arranged in semicircular formation, sometimes took part. From a considerable section of open country the jack rabbits were gathered and driven into a wire enclosure, where they were killed. These drives, carried out within a few hours, usually yielded from 2000 to 3000 jack rabbits, actual count, and in one instance 20,000 were reported. A few coyotes often started along with the jack rabbits, but were usually permitted to escape. The excessive abundance of rodents in many places under varying environmental conditions forces the conclusion that predatory mammals alone are ineffective in controlling their numbers.

Since civilized man has hopelessly overturned the balance by creating artificial conditions and contacts throughout his sphere of influence, practical considerations demand that he assume effective control of wild life everywhere. This means that the rodents and other animals, as well as the carnivores, must be checked wherever they become too numerous or too injurious to human interests.

The larger predatory animals, mountain lions, wolves, and coyotes, by their destructive habits threaten to make ineffective many important measures for game conservation. A predatory-animal hunter who has killed dozens of mountain lions on the Kaibab Plateau in Arizona over a long period, including all seasons of the year, informed me that of many stomachs examined he has never found one that contained anything but the remains of deer, as evidenced by the hair sometimes still attached to pieces of skin, and other easily identified parts.

The control of coyotes presents perhaps the most difficult phase of the predatory-animal problem. These animals breed in great numbers, especially in the unfrequented desert sections of vast extent in western States, from which they pass or overflow into neighboring grazing areas. They are peculiarly favored by their size, which is small enough to enable them to escape easy detection, and to subsist upon game birds, rodents, and other small animals; and yet they are large and powerful enough to constitute a very serious menace as large game and stock

killers. Many young deer, sheep, and calves become their victims. Coyotes have shown a very remarkable, somewhat foxlike, adaptability to the changed conditions brought about by human occupation, and appear actually to be extending their range. In recent years they have pushed northward through British Columbia to the upper part of the Yukon Valley, where formerly they did not occur. They are now being reported from localities to the east of their former habitat on the western plains, and many observers are of the opinion that within recent years coyotes have penetrated farther into the higher and rougher sections of western mountains, where they are able to prey upon the retreating game and livestock.

Lynxes and bobcats subsist largely upon rodents and birds, including game species, but frequently attack game animals, such as deer and antelope, and livestock, and therefore require control. Bears, more omnivorous in habits, are not generally very destructive to game and domestic stock, but individuals sometimes become such confirmed stock killers that their presence on the range can no longer be tolerated.

The aggregate economic value alone of wild animal life in the United States may be measured in many millions of dollars; and its recreational and educational value is incalculable. Proper administration of such resources requires definite knowledge of the ecological relations that through human occupation of the country have, as we have seen, undergone and are still undergoing changes. Many of the results of the expansion of civilized man so disastrous to wild animal life, as, for example, the passing of the wild buffalo, are inevitable; others may be modified or minimized by wise conservation measures. Careful distinction must be made between species which are useful or harmless and their perpetuation to be fostered, and species which are so destructive that their effective control becomes an economic necessity, as well as in the interest of other valuable forms of wild life.

The disastrous effect of predatory mammals on game has been clearly demonstrated, but not always fully realized. In various parts of the west, where through systematic efforts the predatory mammals have been greatly reduced in numbers, there has followed a marked increase in deer, wild turkeys, sage hens, quail, and other game species. Although many predatory mammals ranging on a western game preserve were killed, a herd of 64 antelope was rapidly exterminated due to the coming in of predatory mammals from a distance. Where large predatory mammals are numerous in national parks they not

only tend to check the reasonable increase, but often threaten the extermination of the game upon which they must necessarily live; and owing to roving habits are sure to spread into surrounding territory, where, through attacks on livestock, they become a local pest that will not be tolerated.

As nature lovers we are loath to contemplate the destruction of any species, but as practical conservationists we are forced by the records to decide against such predatory animals as mountain lions, wolves, and coyotes. We can not consistently protect them and expect our game to be maintained in satisfactory numbers. Such a course would also alienate the livestock industry, the interests of which must be considered in connection with game administration, and would arouse opposition to such conservation projects as the establishment of game preserves, which might otherwise be favored. The great range of mountain lions, from southern South America, and of wolves, from Mexico, to far northern latitudes will long prevent their extermination in the less intensively occupied regions. As for the coyotes, effective control is the urgent first need, as their extermination is apparently a practical impossibility.

A look backward to the tremendous changes that have taken place during the past century brings to us a realization of the complexity of modern civilization, with the balance of nature, never perfect, now completely overthrown; a look forward to the progressive expansion of the future reveals greater general economic pressure, more insistent demands for the exploitation of unutilized natural resources, and an ever-increasing struggle for food. Large predatory mammals, destructive to livestock and to game, no longer have a place in our advancing civilization. To advocate their protection in areas occupied by the homes of civilized man and his domestic animals is to invite being discredited as practical conservationists and to risk through prejudice the defeat of measures which may be vital to the future welfare of the country.

Biological Survey, Washington, D. C.

FOOD PREDILECTIONS OF PREDATORY AND FUR-BEARING MAMMALS[1]

By Joseph Dixon

[*Plate 4*]

Certain fur-bearing mammals such as the coyote and the wildcat are commonly referred to as "predatory" animals. Other species, such as the mink and the marten, while just as truly predatory, are classed as "fur-bearing" mammals. The general methods which I have followed in determining the food habits and economic status of the various species have been the same in all cases. Either the term "predatory" or "fur-bearing" can be used with propriety.

The fur-bearing mammals of California each year yield the 3500 licensed trappers of the state a cash income of $350,000.00. I believe that, if all of my readers owned, together, a business or investment that would yield a yearly income of over one-third of a million dollars, they would see to it that said investment remained intact and capable of maximum production. In the case of fur-bearing mammals all agree that an adequate breeding stock is necessary if production is to be kept up to ideal standards. Because of this and other bearings it is important that food habits, rate of reproduction, and natural death rate of our fur-bearers be established. For these reasons, the Museum of Vertebrate Zoology of the University of California has undertaken a special study of the fur resources of California.

In seeking to determine the general economic status of a typical fur-bearer we should consider the following items.

On the one side we have:	On the other side:
Credit	*Debit*
1. Value of pelts produced	1. Destruction of game
2. Harmful rodents destroyed	2. Destruction of domestic animals
3. Injurious insects eaten	3. Transmission of disease
4. Recreational value	

It will be seen that four out of the seven items just mentioned have to do with the food of fur-bearers. In many cases the question of

[1] The present paper is a portion of one read at the sixth annual meeting of the American Society of Mammalogists held at Cambridge, Massachusetts, April 15–17, 1924. Contribution number 431 from the University of California Museum of Vertebrate Zoology.

food must be the deciding factor in determining whether a given species is harmful or beneficial to man's interests.

During the past three years I have spent the greater portion of my time in finding out about the food and natural history of our fur-bearing mammals. There are various ways of ascertaining what a given species of animal eats. One of the most direct and accurate methods is by examination of stomach contents. The value of stomach examination, as applied to birds, has been widely recognized. For instance, we are all familiar with the notable work of Dr. A. K. Fisher on the food of hawks and owls. What would be more logical than to apply the same method to meat-eating mammals as has proven effective in the case of meat-eating birds? Is it not just as fair to judge the economic status of a wildcat by a study of its stomach contents as it is to judge that of a red-tailed hawk by the food found in its stomach?

Of course, we recognize at once that fur-bearing mammals have series of sharp teeth with which to rend and cut up their prey, while hawks and owls have only hooked beaks. People have assured me that it would be impossible to identify stomach contents of fur-bearing mammals because, they were confident, the food would be too well masticated. This has not proved to be the case (see plate 4). I have found the contents of wildcats' stomachs to be quite similar to the stomach contents of horned owls. From my own experience I now know that there are relatively few carnivorous mammals in which identification of food remains is not feasible. I have found the food of the otter chewed the finest and hence most difficult to identify. Mink are much easier than otter. Bobcats and mountain lions just chop up their food and swallow it in chunks, as do also coyotes and foxes. Even beavers and muskrats do not chew their food as finely as we might suppose, and identification is, even in their cases, not usually difficult.

I have found the following to be the best clues by which stomach contents of fur-bearers may be identified. Mammal remains can be identified by the presence of teeth, feet, claws and hair (see plate 4). Birds may be best told by feet, claws and bills. Feathers are sometimes difficult to identify. The hard parts of insects, particularly mouth parts, wings and legs, assist in identification. Fortunately in insects the species involved are for the most part of large size, well-known, and hence easily identified. The skin and feet of toads and frogs help in identification, as do also the scales of fishes.

In this study, stomach examinations have been carried on both in the field (see fig. 1) and in the laboratory (see fig. 2). I have personally

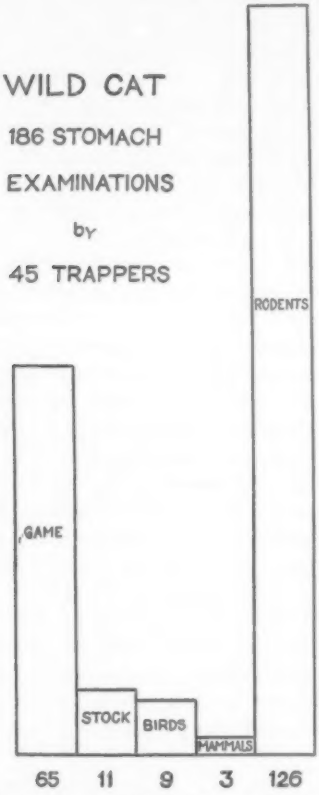


FIG. 1. FOOD OF WILDCATS AS DETERMINED BY FIELD EXAMINATIONS BY LICENSED TRAPPERS

The numbers at the base of the diagram show the number of stomachs which contained game, stock, rodents, etc. Note that rodents outnumber all other items combined. ("Game" in some cases includes bait.)

examined over 1000 stomachs of fur-bearers and have 400 more, preserved in 4 per cent formalin, on hand to examine. I have also been able to interest many of the licensed trappers of the state so that they

have examined and reported, on blanks provided for the purpose, the stomach contents of 1600 additional fur-bearers which they as trappers have caught for the pelts. I have thus now available over 2500 stomach examinations from a single state, and I believe that this will afford some definite evidence as to what the fur-bearers in California actually eat.

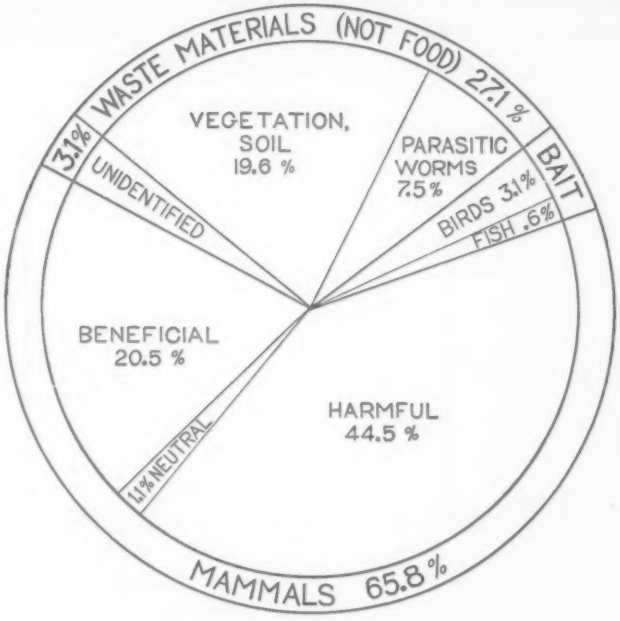


FIG. 2. DIAGRAM SHOWING STOMACH CONTENTS OF WILDCATS AS EXAMINED IN LABORATORY BY JOSEPH DIXON

Note the preponderance of harmful mammals

My laboratory work has been checked against the examinations made by trappers in the field and the two coincide quite closely (see fig. 3). If all the stomachs were examined by one man, it might be claimed that he was prejudiced for or against fur-bearers. However, where there are 40 or 50 men distributed over a large state, each work-

ing entirely independently of the others and all get similar results, we cannot well doubt the significance of their findings, especially when the trapper's findings check so closely with examinations made in the laboratory. This is well illustrated by stomach examinations of the wildcat (see figs. 1, 2, 3).

In every case the species, date, locality, sex, and a record of the bait used in trapping the animals, is recorded in lead pencil on a tag which is attached by the trapper to each stomach. I have thus been able to

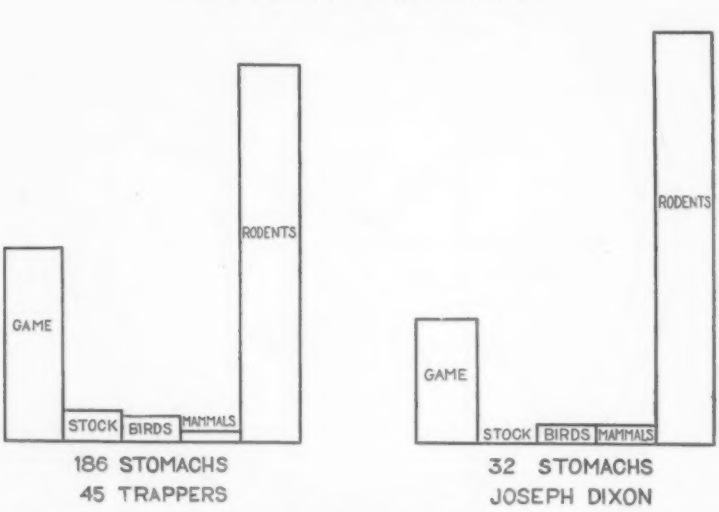


FIG. 3. COMPARISON OF FOOD OF WILDCATS AS DETERMINED BY FIELD AND LABORATORY EXAMINATIONS OF STOMACHS

Note similarity of results

separate bait from other food in the stomach (see fig. 4). If we are to arrive at valid conclusions it is essential that we know which items of food in a stomach represent bait or carrion. This is particularly true of such carrion eaters as the coyote. We find through an examination of 185 coyote stomachs that 70 of these stomachs contained remains of domestic stock (see fig. 4). In 10 cases out of the 70, horses had been eaten. Investigation showed that these horses had not been killed by the coyotes but that they had died of accident or disease; in

a number of cases they had even been killed by man for the express purpose of supplying food for coyotes in order that the coyotes might be attracted to the carcasses where they could be trapped or poisoned. Furthermore, coyotes habitually live largely on "dead" domestic stock and to a lesser extent on "dead" game. In many coyote stomachs, I have been able to distinguish carrion from fresh meat. After impartial study I have come to the conclusion that one-half of the domestic stock, one-fourth of the game and one-eighth of the rodents, found

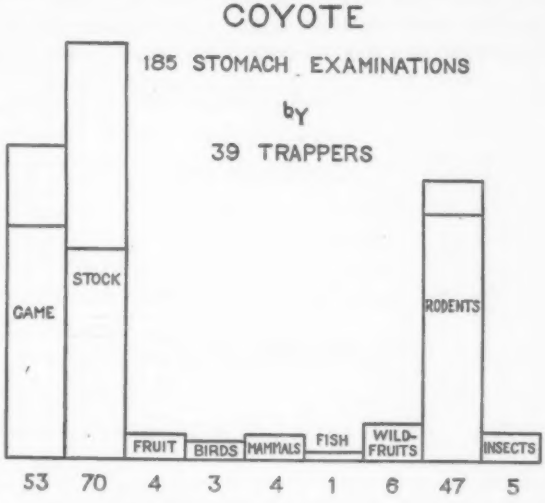


FIG. 4. DIAGRAM SHOWING FOOD OF THE COYOTE

Numerals at base indicate number of stomachs which contained game, stock and rodents. The portions above the cross lines represent carrion; thus ½ the stock, ¼ the game and ⅛ of the rodents eaten were not killed by the coyotes.

in coyote stomachs represent carrion and not animals which the coyotes have themselves killed. In figure 4 that portion of stock, game and rodents above the cross line represents carrion and should not be charged against the coyote. In my records, bait is always indicated by underlining that item.

It is well known that certain species such as the weasel may, when opportunity offers, kill far more than it can eat. Coyotes occasionally do this also, but more often they eat dead animals which they did not

kill. Because we find cow hair in a skunk's stomach we do not jump to the conclusion that the skunk had killed the cow. On the other hand, adult mountain lions rarely eat animals other than those which they themselves kill.

An examination of many stomachs of the mountain lion from various parts of California has shown that domestic stock constitutes, on the average, less that 10 per cent of all food eaten by these animals (see fig. 5). Current statements to the effect that each mountain lion in the western states kill on the average $1000.00 worth of domestic stock each year, would therefore appear to need a considerable reduction, especially since a lion normally lives several years. We may

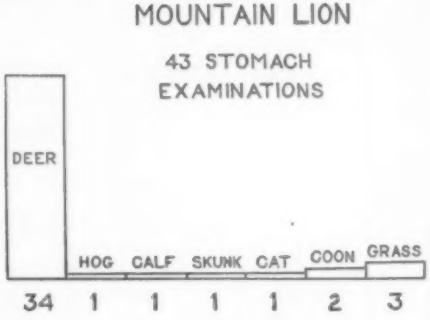


FIG. 5. FOOD OF THE MOUNTAIN LION AS DETERMINED BY STOMACH EXAMINATIONS

Note that only 2 stomachs out of 43, less than 5 per cent, contained domestic stock, while 34 out of 43, or 80 per cent, contained deer.

justly judge the extent of damage done to stock by the average mountain lion from the fact that it is difficult to get cattlemen or sheepmen to pay more than $20.00 bounty for each and every mountain lion killed on their stock ranges.

On the other hand, mountain lions have proved to be exceedingly destructive to deer, since 34 out of 43 stomachs contained remains of deer. This, then, is the real reason why bounty has been paid on over 4000 mountain lions that have been killed in California since October 1907, by the California State Fish and Game Commission.

All stomach examinations must be checked against field experience, in arriving at valid conclusions, and in the present investigation this has been done.

In determining the food of birds by stomach examination, three general methods of recording stomach contents have been used, as follows:

1. Numerical method; for example, 1 meadow mouse, 1 chicken, 1 gopher.

2. Percentage by weight; for example, meadow mouse 30 grams, chicken 50 grams, gopher 100 grams.

3. Percentage by bulk; for example, meadow mouse 25 per cent, chicken 35 per cent, gopher 40 per cent.

Each of these methods has its good points. All three methods have been used in my work upon mammals and have been checked against one another. In the aggregate I find that 1 cc. of well-chewed material in the stomach of a carnivorous mammal weighs 1 gram. Conversely, if the stomach contents weigh 100 grams I have found, by actual test, that the capacity of that stomach will be close to 100 cc. I have thus been able to determine how much food constitutes a square meal for each species in the wild (see table below) and this information has a direct bearing upon fur-farming. For instance, a man who wishes to start a beaver farm wants to know how much willow bark a beaver consumes each day under natural conditions. I can tell him.

Largest meals

SPECIES	WEIGHT	MENU
	grams	
Bear	4530	Hog meat
Mountain lion	3624	Deer meat
Beaver	1100	Cottonwood bark
Coyote	791	2 ground squirrels
Bobcat	269	3 wood rats
Coon	205	Carp
Otter	160	Fish
Skunk	152	*Rabbit*
Badger	135	Ground squirrel
Gray fox	80	1 brush rabbit
Kit fox	57	*Jackrabbit*
Spotted skunk	51	*Rabbit*
Mink	47	Fish
Possum	41	1 chicken
Marten	27	*Trout*

Note: Italicized items equal bait. It is likely that further examinations will reveal still larger meals, especially among the smaller mammals. Figures here listed are extreme not average.

After the stomach contents are weighed in toto, the various kinds of materials are sorted out and then piled separately to approximately equal heights on a large glass plate which is ruled off into 20 squares of equal size. Thus each square equals 5 per cent of the total. If the material covers only 4 squares then each square equals 25 per cent of the total. This method gives the rough percentage by bulk. In many cases the various materials are both measured and weighed. I could use weight alone; but feathers and insects have relatively low specific gravity, that is, they do not weigh as much bulk for bulk as

MEPHITIS

NO.	SEX	DATE	LOCALITY	WEIGHT	STOMACH CONTENTS
354	♂	NOV. 18, 1922	PLEYTO, MONTEREY CO.	24-10	JERUSALEM CRICKETS 100 %
358	♂	DEC. 10, 1922	ORLAND, GLENN CO.	70-22	1 CHICKEN 100 %
362	♀	DEC. 18, 1922	ORLAND, GLENN CO.	36-17	JERUSALEM CRICKETS 80 %, 1 MILLIPED 20 %
351	♂	NOV. 11, 1922	WATSONVILLE, SANTA CRUZ CO.	105-15	JERUSALEM CRICKETS 60 %, GRASSHOPPERS 35 %, PARASITES 5 %
336	♂	FEB. 5, 1922	WATSONVILLE, SANTA CRUZ CO.	20-15	MEADOW MOUSE 50 %, PARASITIC WORMS 50 %
365	♀	DEC. 20, 1922	ORLAND, GLENN CO.	40-20	1 GOPHER 100 %
312	♂	NOV. 1, 1922	MARIPOSA, MARIPOSA CO.	34-12	SOIL 20 %, JERUSALEM CRICKETS 80 %
313	♀	DEC. 24, 1922	MARIPOSA, MARIPOSA CO.	36-16	SOIL 30 %, MEADOW MOUSE 40 %, NUTTALL SPARROW 30 %
312	♀	DEC. 28, 1922	MARIPOSA, MARIPOSA CO.	69-15	SOIL 20 %, 1 FROG 10 %, JERUSALEM CRICKETS 70 %
286	♂	FEB. 6, 1923	WATSONVILLE, SANTA CRUZ CO.	42-12	RABBIT 80 %, PARASITIC WORMS 20 %

FIG. 6. THE RESULTS OF LABORATORY EXAMINATIONS OF STOMACHS ARE LISTED AS HERE SHOWN

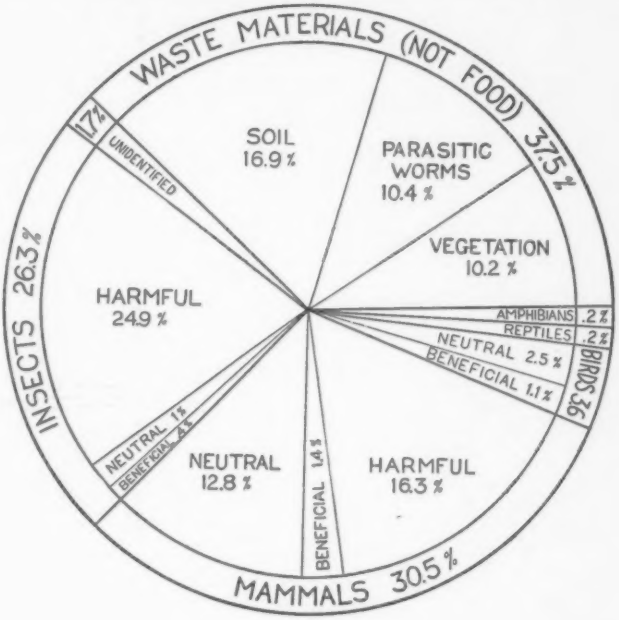
The difference between the two weights given equals the net weight in grams of stomach contents. Bait is always underlined. Percentages given are by bulk.

meat or bone. Weight in such cases, would give false percentages. I have tested both methods on the same material, and while weights are very useful in a general way, percentage by bulk is fairer. I do not try to work closer than 5 per cent, since it is often impossible to sort out all the fine materials and earth. As it is, I sometimes have to spend a whole hour in determining the contents of a coyote's stomach. There is an inevitable percentage of error within which it is useless to figure.

After I have ascertained the percentage of various materials a formal record is made listing the materials according to a uniform tabulation

—under waste materials, birds, mammals, insects, and other headings as the need arises (see fig. 6).

After the original stomach blank is filled out, the various materials are listed on another sheet in three columns—under harmful, neutral, or beneficial. In determining which species in California are harmful,



SKUNKS

FIG. 7. DIAGRAM SHOWING PERCENTAGES, BY BULK, OF VARIOUS KINDS OF FOOD EATEN BY SKUNKS, BASED ON LABORATORY EXAMINATIONS OF STOMACHS BY JOSEPH DIXON

neutral, or beneficial I take the opinion of Grinnell on birds, Essig on insects, and pass judgment on mammals myself. In case of doubt the material is classed as neutral. Most of the species are common and well-known, such as Jerusalem crickets, gophers, ground squirrels and game. If I get "stuck" on an insect or a fish scale I send it to a specialist.

Instead of a regular reference collection of plant seeds, I have made up in a series of glass vials, a collection of hairs, teeth and claws of various mammals such as jack rabbits, ground squirrels, gophers, woodrats, meadow mice and other common species. These samples aid in rapid and positive identification of the materials in stomachs.

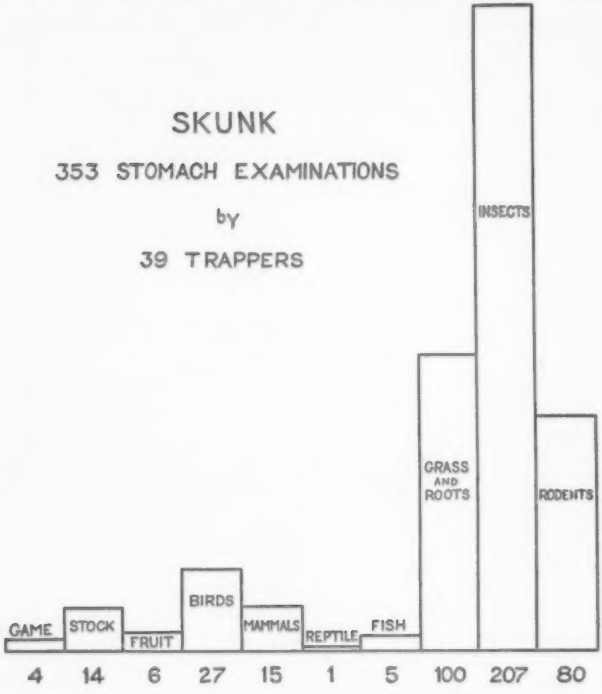


FIG. 8. FOOD OF SKUNKS AS DETERMINED BY FIELD EXAMINATIONS BY LICENSED TRAPPERS

Numbers at base of diagram indicate numbers of stomachs which contained game, stock, insects, etc. Insects (injurious) are eaten more frequently than any other kind of food. (See also fig. 7.)

After I have ascertained the various percentages of food eaten, the results are shown graphically by the familiar method of using a sector of a circle (see fig. 7). This result is then checked against the results of stomach examinations by the licensed trappers in the field (see

fig. 8). It has been my experience that food varies greatly with locality as well as with the season of the year. Thus, coyotes in northern California show a high percentage of game and domestic stock eaten; while stomachs of coyotes from certain southern sections show ground squirrels and jack rabbits predominating. We have tried to secure data for every month in the year. The bulk of our material has, however, been taken during the trapping season, winter and early spring,

Fig. 9.

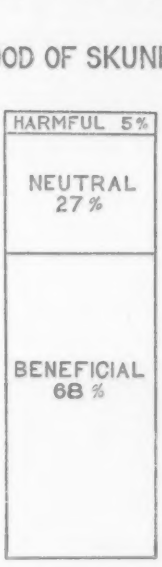


Fig. 10.

Fig. 9. Final Summary, Showing that 63 Per Cent of the Wildcat's Food Is of Beneficial Significance from the Human Standpoint

Fig. 10. Final Summary, Showing that 68 Per Cent of the Skunks' Food Is of Beneficial Significance from Man's Viewpoint

when food is scarcest and hence actual damage by predatory mammals to the flocks and herds of man is greatest.

In deciding whether a species of fur-bearer is harmful, neutral or beneficial many other things besides stomach contents must be taken into account. Hence our final summing up is based upon field experience of many observers, upon examination of feces, and upon stomach contents. After all possible information is in, it is summed up

with a final statement of percentages of harmful, neutral and beneficial status of each species (see figs. 9 and 10).

As a result of this study, I find that in California certain so-called predatory mammals such as the wildcat and the skunk are, in the aggregate, beneficial and not harmful to human welfare. The actual figures, taking all reliable sources of information into consideration, show that 63 per cent of the food of the wildcat in California is of beneficial significance with regard to man's interests while 10 per cent is neutral and only 27 per cent is of harmful significance (see fig. 9). In the case of the skunk, the data obtained from an examination of somewhat over three hundred stomachs show (see fig. 10) that from man's viewpoint 68 per cent of the skunks' food is of beneficial significance, 27 per cent is neutral, and only 5 per cent of harmful significance.

Conditions elsewhere may or may not be similar to those in California. We, at the Museum of Vertebrate Zoology, are dealing with the problem as presented in our immediate territory. In view of these and other similar findings, I believe that, in many instances where extermination is advocated, we are getting "the cart before the horse." I firmly believe that it would be best for all concerned to have first a fair and impartial determination of the facts as a basis for a much-needed, sane, administration of the animal assets (or liabilities) in question.

Berkeley, California.

TYPICAL FOOD MASS OF THE WILDCAT JUST AS REMOVED FROM THE STOMACH; SHOWING FEET OF NEOTOMA AND MICROTUS

PART OF STOMACH CONTENTS OF ONE WILDCAT

Note 5 hind feet of *Neotoma* (upper row). The tails have been bitten through at regular intervals, but not completely severed.

ON THE STUDY OF SCATOLOGY

By Ernest Thompson Seton

Scatology, as a definite department of zoology, has not, so far as known, ever had formal consideration. Every field naturalist and hunter knows that, next after the animal itself, the scats and the tracks together afford the most information on the habits, food, and whereabouts of the creature. I do not know of any attempt, outside of my *Life-histories* (1909), to picture and discuss these interesting and material records, oftentimes the only ones we have of the presence of certain animals.

Approached as a basis of classification, I find that the form and substance of the scats is an excellent—yes, a quite reliable—guide to the *order* of a creature. Thus all of the pachyderms have their rectal output of the same type and nearly the same color, substance, and odor as that of the horse, while a similar kinship is shown among those of the ruminants. Those of Carnivora, Rodentia, Insectivora, etc., each show a style that clearly and exclusively belong to the order in question, and is a reflex of their peculiar anatomy.

Accepting the form of the dung pellets as a diagnostic of ordinal value, the simplicident rodents and the duplicident rodents are of wholly different orders. The sheep and the deer, however, would, by this test, be lumped in one.

As a family feature, the scatology has little value, and as a generic feature, none whatever. And now, we meet with a final surprise. Though useless as a generic character, the scats are extremely valuable and helpful as a specific character, because here we receive to the full the helpful information of size and constituents.

Thus, the output of fox and wolf may be of precisely the same form, but the great difference of size and the fact that the fox will contain more or less mouse traces, and the wolf the remains of deer and cattle to the exclusion of mice, will usually settle the question. Or again, lynx and fox scats may be of exactly the same size and color, but the presence of seeds, berries, or insects in the latter, and the exclusively animal nature of the former, helps to a satisfactory decision.

The disposal of the scats, that is, the creature's slow, blind gropings toward sanitation, open up another most interesting subject. There are two, or perhaps three, established systems to effect this, all three long known in the animal world, but very recent among ourselves.

These are the wet system, the dry system, and the parasitic or antiseptic system.

The wet system. In the case of the cats, we find that they use two, may be all three, methods. Those species which live in well-watered forests habitually drop their dung in water, and those to whom water is not available, bury it.

A pair of Uinta bobcats that I kept in my menagerie for over a year were very careful about their sanitation. At least, I suppose they thought so. For regularly, after their morning drink, they turned about and carefully dropped their excretes in the water trough. In the cage, this was, of course, unclean, but in natural surroundings would have been quite correct, for our engineers assure us that sufficient dilution is disinfection.

The principle is clearly recognized in a Mosaic ordinance. After listing a vast number of things as unclean, and stating that any of these falling into a drinking vessel pollute it with its contents, so both must be destroyed, the Great Lawgiver adds: "Nevertheless, a fountain or pit wherein there is plenty of water, shall be clean" (Leviticus, XI, 36).

The dry system. The dry earth plan is that of the many creatures who bury their dung. The highest development of this is seen among animals like the pocket-gopher and kangaroo-rat, whose labyrinthine dwellings are equally well equipped with food storerooms and dry earth sanitation closets. However, this system also is practiced by many cats, all, I think, whose native surroundings are arid and nearly waterless. When at home they are accustomed to bury their dung in the sand. In the zoo, they are careful at least to deposit it in one corner of the cage, often going through the motions of burying it, though no loose material be available.

The third plan, is of course, quite unconsciously followed; that is, the fecal output is left exposed to special insect parasites that speedily render it innocuous. An interesting illustration of this comes to me from Nova Scotia, and refers to the big wildcat of that province. Arthur R. Rice tells me that there is near Digby, Nova Scotia, a long glacial dump. On this are a great many ant hills, and on every ant hill a wildcat has left a pile of its excretes.

Dogs follow the dry plan. They keep their dens clear and commonly show a disposition to scratch some earth onto their dung deposit. This they do with their hind feet. The two or three vigorous scratch-marks of the wolf are often seen.

When Metchnikoff, in his 'Prolongation of Life,' demonstrated to

the world that the lower colon was the breeding place of parasitic flora and fauna, which were probably responsible for man's shortened span of existence, he at least opened a new field of research.

In my *Life-histories*, I demonstrated that no animal can have a home—that is, a prepared, fixed and permanent refuge from the weather,—unless it has developed the rudiments of sanitation; which carries with it *a limitation of the number of daily evacuations*. This further implies a great increase in the size and storage capacity of the lower colon.

For example, none of the deer tribe in America have a home. Normally, the white-tailed deer evacuates every hour of its active life, which may mean 20 or more times a day. On the other hand, wolves and cats have homes, which they are careful not to defile with excretes. Judging from observations in the Zoo, these animals evacuate once, or at most twice, a day.

These long retentions presuppose a colon of increased size and length; that is, a longer exposure of the animal's power of resistence to the poisons of the food-waste, which hourly becomes more deadly.

If this be a proper application of Metchnikoff's theory, it should secure for the free-roving, oft-evacuating deer, a vastly longer span of life than the den-loving animals, such as wolves and coons. However, it does not appear to have worked out that way.

Greenwich, Conn.

A NEW HOG-NOSED SKUNK

By Frederic W. Miller

[*Plate 5*]

The relative scarcity of skunks of the genus *Conepatus* in collections is comparable to the lack of accurate information regarding their distribution. The genus occurs throughout the major portion of South America and ranges north to many points along our southwestern border. Its presence in Colorado, however, was wholly unsuspected. In the Journal of Mammalogy, vol. 2, no. 2, it was reported by Mr. E. R. Warren from the vicinity of Colorado Springs; a matter of note as it extended the known range of the group some hundreds of miles north. Field work by the Colorado Museum of Natural History in Baca County during the past two years has revealed the presence of hog-nosed skunks in that portion of Colorado and specimens from that locality have proven to represent a hitherto undescribed race which it is proposed to call

Conepatus mesoleucus figginsi[1] **subsp. nov.**

Type.—Adult male, Colorado Museum of Natural History, No. 1961, from Furnace Canyon, western Baca County, Colorado.

Distribution.—Warm Sonoran valleys of Baca and Las Animas Counties Colorado; limits of range unknown.

General characters.—A large, northern race of the *mesoleucus* group most nearly allied to *C. m. mearnsi*.[2] Skull more massive and rugged and differing in detail.

Skull.—Compared with that of *C. m. mearnsi*, the skull is larger, more rugged and angular, with sagittal and occipital crests high and pronounced; zygomata more widely spreading; mastoid breadth greater; postorbitals and frontals much inflated; pterygoid fossa slightly narrower; dentition heavier.

Color.—Dorsal surface from occiput to end of tail, white; sides shiny, jet black, with a small white spot at the base of the ear; underparts dull black with a varying amount of white on the chin.

Measurements.—(Type) Total length, 734; tail vertebræ, 232; hind foot, 77. *Skull* (type), greatest length (median line) 78.2; basilar length, 70; zygomatic breadth, 54; constriction behind zygomata, 41.6; mastoid breadth, 45.2; width of interpterygoid fossa, 8; front of canine to back of last upper molar, 23.2; length of incisor series, 11.5; interorbital breadth, 23.2.

---

[1] Named for J. D. Figgins, director of the Colorado Museum of Natural History, in recognition of his services to Colorado mammalogy.

[2] The museum in indebted to the U. S. Biological Survey for the loan of a series of *C. m. mearnsi* for comparison, without which this study would be necessarily unsatisfactory.

TYPE SKULL OF CONEPATUS MESOLEUCUS FIGGINSI

(Miller; A New Hog-nosed Skunk)

Remarks.—Of particular note is the extreme depth of the skull with mandibles in situ, which gives the skull a decided bull-dog appearance. Measured on a vertical line across the tips of the nasals (with jaws in place) *figginsi* measures 33 (average of two adult males) as compared with 29 in *mearnsi* (average of two adult males).

Hog-nosed skunks are frequently met with in the vicinity of Furnace Canyon and Carrizo Creek, Baca County, Colorado, though they are not nearly as abundant as the other skunks. The local trappers, however, secure a number annually They stay largely in the piñon scrub where they root up considerable areas of the sandy soil in search of food. These areas are often forty feet in diameter and are thoroughly worked for a depth of several inches.

Colorado Museum of Natural History, Denver.

PRELIMINARY DESCRIPTIONS OF FIVE NEW CHIPMUNKS FROM NORTH AMERICA

By Arthur H. Howell

Since the publication of seven new races of *Eutamias* by the writer in 1922,[1] further studies in the group have led to the recognition of four additional forms in this genus and one of the eastern chipmunk (*Tamias*). These new forms are here briefly described in order that the names may be made available for use in advance of the publication of the complete revision of the group, which may be somewhat delayed.

Tamias striatus fisheri[2] subsp. nov.

FISHER CHIPMUNK

Type.—No. 193370, U. S. Nat. Mus. ($\frac{8\,0\,1}{1\,2\,3\,8}$, Merriam collection); ♀ subadult, skin and skull; collected at Merritt's Corners, four miles west of Sing Sing [=Ossining], New York, August 23, 1884, by A. K. Fisher.

Subspecific characters.—Similar to *Tamias striatus striatus* of the southern Alleghenies, but paler, especially the rump, feet, and sides of head and body; dorsal area much more grayish (less ochraceous or tawny); light dorsal stripes clearer white (less shaded with ochraceous); head and underside of tail averaging paler. Compared with *T. striatus griseus:* Size smaller; sides of head and body averaging darker; gray of upperparts less extensive and slightly darker (especially in winter pelage); underside of tail slightly darker.

---

[1] Journ. Mamm., vol. 3, no. 3, pp. 178–185, August, 1922.

[2] Named for Dr. Albert K. Fisher, of the U. S. Biological Survey, who collected the type series.

Measurements.—Type (♀ sub-adult): Total length, 257; tail vertebræ, 88;[3] hind foot, 35;[4] ear from notch, 13. *Skull.*—Greatest length, 40; zygomatic breadth, 21.1; breadth of cranium, 16.6; least interorbital breadth, 9.8; postorbital breadth, 11.5; length of nasals, 13.4.

Remarks.—This race occupies the Middle Atlantic States from the lower Hudson Valley, New York, south to southern Virginia and extreme eastern Kentucky, and west to Ohio. It is intermediate in coloration between *striatus* and *lysteri*.

Eutamias minimus grisescens subsp. nov.

COULEE CHIPMUNK

Type.—No. 89701, U. S. Nat. Mus. (Biological Survey collection); ♂ subadult, skin and skull; collected at Farmer, Douglas County, Washington, July 31, 1897, by J. Alden Loring; original number, 4539.

Subspecific characters.—Similar to *E. minimus pictus*, but smaller, especially the hind feet; coloration decidedly more grayish and less buffy; dark dorsal stripes relatively narrow and median pair of light stripes much broader; tail averaging paler and more grayish.

Measurements.—Type (♂ subadult): Total length, 167; tail vertebræ, 76; hind foot, 27; ear from notch, 10. *Skull.*—Greatest length, 29.3; zygomatic breadth, 15.7; breadth of cranium, 13.3; least interorbital breadth, 6.7; length of nasals, 8.4.

Remarks.—This race apparently occupies a very restricted area in eastern Washington, being found in its typical form only in the "Coulee" region east of the Columbia River, in Douglas and Grant Counties.

Eutamias minimus confinis subsp. nov.

BIGHORN CHIPMUNK

Type.—No. 168957, U. S. Nat. Mus. (Biological Survey collection); ♀ adult, skin and skull; collected at head of Trapper's Creek (8,500 feet altitude), west slope of Bighorn Mountains, Wyoming, June 7, 1910, by Merritt Cary; original number, 1956.

Subspecific characters.—Similar to *consobrinus*, but larger; upperparts in winter pelage more buffy (less grayish), particularly on the thighs and buttocks; median pair of light dorsal stripes stongly mixed with buff (less clear gray); dark dorsal stripes blackish, mixed with ochraceous-tawny (in *consobrinus* nearly russet); hind feet paler; in summer pelage, dark dorsal stripes averaging less blackish and thighs more buffy. Compared with *pallidus:* Upperparts, sides, and under surface of tail decidedly darker. Compared with *oreocetes:* closely similar in color, but ears showing conspicuous blackish patches; postauricular patches less conspicuous and more buffy (less whitish); nape usually washed with smoke gray; hind feet paler (less tawny).

---

[3] Measured dry.

[4] Relaxed.

Measurements.—Type (♀ adult): Total length, 204; tail vertebræ, 90; hind foot, 33; ear from notch, 11.5. *Skull.*—Greatest length, 30.9; zygomatic breadth, 17.7; breadth of cranium, 15.4; least interorbital breadth, 7.3; length of nasals, 10.

Remarks.—The Bighorn chipmunk is closely related to *pallidus*, which occupies the surrounding plains, but like all the mountain-dwelling forms in this group it is darker than the plains form. It is also closely similar to *oreocetes* of the high mountains of northern Montana, but differs from it in several characters, and occupies an area widely separated from the range of that race. From *consobrinus* which occupies the high mountains in western Wyoming it differs both in size and color.

Eutamias minimus jacksoni[5] subsp. nov.

LAKE SUPERIOR CHIPMUNK

Tamias quadrivittatus neglectus ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 3, p. 106, June, 1890 (in part—specimens from Minnesota).

Eutamias quadrivittatus neglectus MILLER AND REHN, Proc. Boston Soc. Nat. Hist., vol. 30, p. 44, 1901 (and of authors generally).

Type.—No. 227423, U. S. Nat. Mus. (Biological Survey collection); ♂ adult, skin and skull; collected at Crescent Lake, Oneida County, Wisconsin, September 7, 1917, by H. H. T. Jackson; original number 927.

Subspecific characters.—Similar to *E. minimus borealis* but upperparts and tail more intensely tawny; head and facial stripes slightly darker; median pair of dorsal stripes more strongly tinged with sayal brown; tail darker, both above and below.

Measurements.—Type (♂ adult): Total length, 209; tail vertebræ, 89; hind foot, 33; ear from notch, 13. *Skull.*—Greatest length, 32.9; zygomatic breadth, 18.1; breadth of cranium, 14.5; least interorbital breadth, 7.2; length of nasals, 9.8.

Remarks.—This is the form which Doctor Allen intended to characterize when he named *neglectus*. He had at that time only 7 specimens—two from Montreal River, eastern end of Lake Superior, two from North Pacific Junction, Minnesota, and three from Escanaba, Michigan (the last in too poor condition for comparison). Unfortunately he selected one of the specimens from Montreal River as the type and this form proves to be inseparable from *borealis*. Had he chosen one of the Minnesota specimens for a type, the name would stand for the richly colored race inhabiting northern Wisconsin, Minnesota, and Michigan, but in the light of our present knowledge, there seems to be no other course than to place *neglectus* in the synonymy of *borealis* and provide a new name for the form currently known as *neglectus*. This subspecies ranges northward into western Ontario and eastward along the north shore of Lake Superior as far as Nepigon, intergrading in that region with *borealis*.

---

[5] Named for Dr. Hartley H. T. Jackson, of the U. S. Biological Survey.

Eutamias amœnus ochraceus subsp. nov.

OCHRACEOUS CHIPMUNK

Type.—No. 161049, U. S. Nat. Mus. (Biological Survey collection); ♂ adult, skin and skull; collected in Studhorse Canyon, Siskiyou Mountains, California, September 27, 1909, by N. Hollister; original number, 3511.

Subspecific characters.—Similar to *E. amœnus amœnus* but larger; upperparts more ochraceous (less grayish), especially on head and rump; dark dorsal stripes averaging more brownish (less blackish); median pair of light dorsal stripes more mixed with tawny or cinnamon (less clear gray); tail paler, both above and below. Similar to *E. amœnus luteiventris* but dark dorsal stripes less blackish (more brownish); post-auricular patches larger and more distinct; underparts less heavily washed with buff.

Measurements.—Type (♂ adult): Total length, 216; tail vertebræ, 103; hind foot, 33; ear from notch, 14. *Skull.*—Greatest length, 33.5; zygomatic breadth, 18.4; breadth of cranium, 14.5; least interorbital breadth, 7.8; length of nasals, 9.6.

Remarks.—This subspecies is typical only in the Siskiyou Mountain region of northern California and southern Oregon and apparently does not range much northward of that region. Southward, in the Trinity and Salmon Mountains, it intergrades with *amœnus*, the specimens from those ranges being referred to the latter race.

Biological Survey, Washington, D. C.

GENERAL NOTES

THE SOREX ARCTICUS AND SOREX ARCTICUS CINEREUS OF KERR

Continued investigations upon American Soricidæ have led me to search carefully the literature in an effort to reach a comprehensive understanding of the history of the family. Apparently the first mention in literature of a long-tailed shrew inhabiting America is the well known one of Forster who in his "Account of several quadrupeds from Hudson's Bay" remarks under his species 19, Foetid shrew, *Sorex araneus* Linn.: "The specimen is much darker on the back than the European Shrew, its sides are reddish brown" (Forster, J. R., Philos. Trans., vol. 62, p. 380, 1772), and under his species 20: "Shrew, two specimens. The colour is of a dusky grey above, and a dirty white or yellowish below; the nose is very long and slender; the length from the nose to the tail, in the one specimen is 2¼, in the other almost 2 inches; the tail is about an inch and a half long, thinly beset with hairs, brown above and yellowish below. If this species had no tail, I should take it to be the minute Shrew, which the Rev. Mr. Laxman found in Siberia, and which is the *Sorex minutus* Linn" (Forster, l. c., p. 381). In a footnote Forster notes "From the factory at Hudson's Bay, the Royal Society were favoured with a large collection of uncommon quadrupeds . . . . by Mr. Graham, a gentleman belonging to the settlement on Severn River" (Forster, l. c., p. 370).

The first of these shrews which Forster describes is unquestionably the animal generally known as *Sorex richardsonii* Bachman (Journ. Acad. Nat. Sci. Philadelphia, vol. 7, p. 383, 1837) and the other two specimens seem almost equally certain to represent *Sorex personatus* I. Geoffroy (Dictionnaire Class. d'Hist. Nat., tome 11, p. 319, January, 1827), since not only the description fits *Sorex personatus* I. Geoffroy, but also because *Sorex personatus* is superficially very like *Sorex minutus*. The only shrew in the Hudson Bay region which could be confused with *Sorex personatus* Geoffroy is *Microsorex hoyi* (Baird), but the latter is so rare in this region and the former so abundant, the chance of Forster's specimens being *Microsorex hoyi* is so remote as to be nil. Twelve years after Forster's account, Pennant in redescribing the three specimens virtually copied the original description and placed them under "Shrew 67, Foetid?", but used no Latin name (Pennant, T., Arctic Zool., vol. 1, p. 139, 1784).

Turning now to Kerr we find that he has redescribed the Graham (Forster) specimens, basing his descriptions on Pennant (1784, l.c.); to the first of these (i.e., Forster's 19) he gives the binomial *Sorex arcticus* and to the other two (i.e., Forster's 20) specimens he gives the trinomial *Sorex arcticus cinereus* (Kerr, Robert, The animal kingdom, or zoological system, of the celebrated Sir Charles Linnæus, p. 206, 1792). Therefore *Sorex arcticus* Kerr, with type-locality at Severn Settlement (now Fort Severn, mouth of Severn River, Ontario) replaces *Sorex richardsonii* Bachman, and *Sorex cinereus* Kerr, with type-locality also at Severn Settlement, replaces *Sorex personatus* I. Geoffroy.

The recognition of *Sorex arcticus* Kerr also further complicates matters since the name preoccupies *Sorex personatus arcticus* Merriam, which I here rename **Sorex cinereus hollisteri** as a very slight recognition of the worth of the late Ned Hollister as a friend, man, and scientist.

The following changes in the names of American *Sorex* will now be necessary
Sorex richardsonii Bachman becomes *Sorex arcticus* Kerr.
Sorex personatus personatus I. Geoffroy becomes *Sorex cinereus cinereus* Kerr.
Sorex personatus miscix Bangs becomes *Sorex cinereus miscix* Bangs.
Sorex personatus haydeni Baird becomes *Sorex cinereus haydeni* Baird.
Sorex personatus streatori Merriam becomes *Sorex cinereus streatori* Merriam.
Sorex personatus arcticus Merriam becomes *Sorex cinereus hollisteri* Jackson.

—Hartley H. T. Jackson, *U. S. Biological Survey, Washington, D. C.*

SOME PHYSIOLOGICAL OBSERVATIONS ON CAPTIVE SKUNKS

During the past two years two male skunks of the same litter have been kept in the loft of the animal house at the Medical School. The scent glands of these animals were removed nearly two years ago when the skunks were less than three weeks old. Living undisturbed since then in a large room with ample space for exercise these animals have grown to be quite fearless of attendants and even strangers, and were in prime condition when studied. It is thought that the records obtained are typical normals of these wild animals as they could be handled without the usual reactions of fear and anger.

DATE	NUMBER	WEIGHT	ROOM TEMPERATURE	ANAL TEMPERATURE	COAGULATION TIME	BLOOD SUGAR	RESPIRATION RATE PER MINUTE	HEART RATE PER MINUTE
		kgm.	*°C.*	*°C.*	*minutes*	*per cent*		
June 2	I	3.0	25.0	37.5	1.60	0.092	36	160
June 3	I		25.5	37.4	0.90	0.100	38	176
June 5	I		25.5	37.1	0.95	0.110	36	140
June 2	II	3.2	25.0	37.5	0.40	0.110	35	160
June 3	II		25.5	37.4	1.20	0.096	36	170
June 5	II		25.5	37.2	0.70	0.125	34	155
Averages.....		3.1	25.4	37.35	0.95	0.105	36	160

All samples drawn 18 hours after last feeding of the animals.

From the data submitted it may be seen that the pulse and respiration rates were below those of the common cat and more nearly on the level of a small dog. The sugar content of the blood was about the same as that of a cat and higher than that of a dog. On the other hand the body temperature was almost a degree lower than the average body temperature of either cats or small dogs, in spite of the fact that the skunks lived a more active life than either captive cats or dogs. The most surprising reaction was the very rapid coagulation of the blood; in fact the blood of the skunks coagulated so rapidly that it was impossible to draw samples from the ear as is customary with cats and dogs. Consequently a small stab was made on the side of the leg and even from this puncture it was difficult to draw the blood before it coagulated. With a coagulation time of less than one minute the blood of the skunk is in sharp contrast

to the blood of either the cat or the dog, as the blood of those two animals under similar conditions of temperature and humidity would require from 4 to 6 minutes for coagulation. This rapid coagulation time of the skunk blood is evidently of large value to these animals in cases of minor injuries, as Cannon and Mendenhall, Amer. Jour. Physiol., 1914, vol. 34, p. 251, have pointed out that rapid coagulation may be considered as an adaptive reaction serviceable to animals in injury, rage and struggle.—M. M. Ellis and O. W. Barlow, *Dept. of Physiology, University of Missouri, Columbia, Mo.*

SOME NEW RODENT RECORDS FOR NORTHEASTERN CALIFORNIA[1]

In May and June, 1924, field work was carried on by the Department of Ornithology and Mammalogy, of the California Academy of Sciences, in Modoc County, California, where the small settlement of Eagleville was made the principal collecting and observing station.

This little village lies at the eastern base of the Warner Mountains, on the edge of a long strip of meadow land that is irrigated from the mountain streams. East of this narrow meadow is Middle Lake, which, except for a small laguna at its southern extremity, is a lake only in winter and spring. The rest of the year it is but a bare expanse of alkali sand. East again of the lake is a desert of sand, lava and sagebrush that stretches across the close-by state line far into Nevada.

In this desert, at a point about two miles east of Eagleville, it was my good fortune to encounter colonies of both the Columbian kangaroo rat, *Dipodomys ordii columbianus* (Merriam), and the Oregon kangaroo mouse, *Microdipodops megacephalus oregonus* Merriam. These colonies, which appeared to be small ones, were found scattered among the low, brush-grown sand dunes and hummocks that cover that part of the desert. In walking over the dunes my foot frequently broke through the surface into the burrows, many of which appeared to be unoccupied.

The main reason for supposing that the colonies were limited in the number of their respective members was that it seldom was found profitable to trap in a colony for more than one night before moving the traps to another sand dune. Some mornings, however, even when the trap lines had been laid out on absolutely fresh ground, there were rodent tracks all around and often close up to many of the traps, without a single one of them having been sprung or a particle of the bait—consisting generally of rolled oats—having been touched, but in such cases no change was made in the location of the trap line and usually a comparatively fair catch was made the following night.

It seems rather remarkable that neither of the above two genera have heretofore been recorded from this region, for it is in the same valley as, and only about 40 miles south of the old United States army post of Fort Bidwell (now an Indian school) from which many natural history records have been made by army officers of the past generation. It may be either that the above two genera are recent invaders of the northeastern part of California, having come in from Oregon or Nevada, from which states they have been recorded, or that

[1] Contribution from the California Academy of Sciences.

there happened to be a period of extreme low ebb in that portion of the local rodent population at the time when competent observers were working in this field.

The nearest locality along the eastern border of this state from which the genus *Dipodomys* has been recorded is Vinton, 4700 to 5000 feet altitude, Plumas County, where *Dipodomys* (*Perodipus*) *ordii columbianus* was taken.[2]

Singularly enough, the only state record for the genus *Microdipodops* also is from Vinton, where the form *Microdipodops californicus californicus* Merriam, Sierra Valley kangaroo mouse, has been taken. In Modoc County these two genera were apparently occupying actually the same territory, or at the very least, were overlapping each other's colony boundaries, for both were taken indiscriminately in the same set of traps.

Another matter of interest during the stay of the party at Eagleville was the taking of two specimens of *Perognathus nevadensis* Merriam, the Nevada pocket mouse, in the same part of the desert in which the *Dipodomys* and *Microdipodops* were found. This pocket mouse was either very scarce or very wary, for our traps were kept set in this locality for about two weeks, being rebaited nightly and the trap lines frequently shifted a few rods at a time to fresh ground, and yet these two individuals were the only examples of this species that were secured. Both of these are adult males, neither of them quite typical of the race but apparently nearer to *nevadensis* than to anything else. This race is found in adjacent territory, beyond the state line, but has not heretofore been recorded from California.

Another rodent not before recorded from north of Mono County in this state is *Ammospermophilus leucurus leucurus* (Merriam), antelope ground squirrel, which, to judge from the tales of reliable residents, must be numerous at times in the desert on the eastern edge of Modoc County. At the time of the visit of the Academy party only two individuals of this genus were secured, in spite of strenuous efforts to discover more, and it was evident that the *Ammospermophilus* population was at a temporary minimum. In the Museum of Vertebrate Zoölogy, at the University of California, Berkeley, California, however, there is a good representation of the antelope ground squirrel from this region, obtained through other parties by Doctor Grinnell, who has on my behalf courteously waived his prior right to place this species on record for northeastern California.—Joseph Mailliard, *San Francisco, Calif.*

WEIGHTS OF MAMMALIAN GONADS

I have now under study a problem in vertebrate endocrinology for which data on the weights of gonads in various mammals are desired. It was a matter of great surprise to find that there is virtually no information available, at least known to me, giving the body and the testis weights respectively of mammals. Only one article, by A. E. Livingston (Amer. Jour. Phys., vol. xl, no. 2, Apr., 1916), was found which furnishes such information. It concerns rabbits and white rats. Also an extensive correspondence with several teachers of vet-

[2] A Geographical Study of the Kangaroo Rats of California, Univ. of Calif. Pub. in Zoölogy, vol. 24, no. 1, p. 71, 1922.

erinary medicine, and with the scientific staffs of packing companies, failed to elicit any trace of other data bearing on these weights.

Because of the foregoing facts the following list is published in the hope that it may help future workers in biology; these weights have all been secured by me from fresh specimens.

SPECIES (OR ANIMAL)	BODY WEIGHT	GONAD (2) WEIGHT
	grams	*grams*
House mouse	15.5	0.074
Guinea pig	552.8	3.00
Guinea pig	382.7	2.375
Gray squirrel	622.9	5.75
Dog:		
Bull terrier	10944.0	12.90
Bull terrier	9299.2	22.60
Bull terrier	16329.6	31.70
Spitz	8848.0	14.90
Spitz	9699.2	16.00
Spitz and spaniel	13368.0	22.90
Shepherd	24948.8	31.00
Spitz	9699.2	16.00

—W. H. BERGTOLD, *Denver, Colorado.*

THE BRIDLED DOLPHIN (PRODELPHINUS FROENATUS) ON THE FLORIDA COAST

While at Sebastian, Florida, in 1924, Mr. George Nelson secured for the Museum of Comparative Zoölogy a weathered cranium which proves to be that of a Bridled Dolphin (*Prodelphinus froenatus*). This pelagic species seems not to have been recorded hitherto from the coast of North America and is therefore an addition to Miller's List (1924). Apparently it is unusual for individuals of this species to be stranded or washed ashore, for most of the available specimens and records are of animals taken at sea. Probably, too, it frequents the warmer oceanic currents and keeps well off soundings. In this connection I am indebted to Mr. Gerrit S. Miller, Jr., for the opportunity to examine a second cranium of a slightly younger animal, secured by C. M. Baxley near the southern end of Florida at Cocoanut Grove, in May, 1917, and now in the U. S. National Museum (No. 218344). This specimen was likewise picked up on the beach, but is so much fresher in appearance as to suggest that both individuals might have come ashore at about the same time though retrieved nearly seven years apart. These and four other skulls in the Museum agree in general size and proportions, and in the distinct asymmetry of the nasal region, with the intermaxillary of the left side the smaller. At the summit of the cranium, the tip of the supraoccipital is displaced to the left of the median line, while on both sides its anterior edge projects forward so as to overhang the posterior end of the frontal.
—GLOVER M. ALLEN, *Museum Comparative Zoölogy, Cambridge, Mass.*

THE SYSTEMATIC NAME OF THE TEXAS ARMADILLO

In 1864,[1] Peters named the long-tailed armadillos of Costa Rico and Mexico, separating them from the South American *Dasypus "longicaudatus."* The first of the names, *Dasypus fenestratus* (type locality Costa Rica), has been revived for the common armadillo of Middle America and Mexico. After working over the material in the National Museum collection, I can readily agree with Allen[2] that the range of *fenestratus* extends northward over the greater part of Mexico. It includes, indeed, the region (Colima) selected by Bailey[3] as the type locality of *Dasypus mexicanus*.

An examination of the original account of *mexicanus*, however, shows that Peters really described the animal later named *texanum* by Bailey. He compares it with *"longicaudatus"* (which he has just stated is very like his new *fenestratus* from Costa Rica) and gives two of the principal characters distinguishing the armadillo of northeastern Mexico and Texas from *fenestratus*, the suture structure of the skull and the robust teeth, which he states are as represented in the plate published by Baird (Mammals of North America, plate 86). Baird's plate shows several figures of skull number 1409, U. S. National Museum, from Matamoras, representing the form *texanum*, described by Bailey from specimens collected just across the Rio Grande at Brownsville. Bailey's selection of Colima as a type locality for *mexicanus* is therefore untenable, as the form of armadillo found at Colima is clearly not the *mexicanus* of Peters. The form later called *mexicana* by Gray[4] is the *fenestratus* of Peters, and Gray's figure has no bearing on the case. Matamoras, Tamaulipas, Mexico, might well be taken as the type locality of the *Dasypus novemcinctus* var. *mexicanus* of Peters on the basis of the reference in the original description to the figures published by Baird. The armadillo of northeastern Mexico and southern Texas will therefore have to be called *Dasypus novemcinctus mexicanus* Peters.—N. HOLLISTER.

---

[1] Mon.-ber. Kön. Akad. Wiss. Berlin, 1864, p. 180.

[2] Bull. Mus. Comp. Zool., vol. 54, pp. 198-199. July, 1911.

[3] North Amer. Fauna, Nr. 25, p. 52. October 24, 1905.

[4] Hand-list Edentate, Thick-skinned, and Ruminant Mammals, p. 14. 1873.

RECENT LITERATURE

ACKERMANN, OTTO. Neues über das Vorkommen des Ackerknechtschen Organs in der Säugetierreihe. Anat. Anzeiger, vol. 57, pp. 449–472. June 12, 1924.

ANDREWS, ROY CHAPMAN. A remarkable case of external hind limbs in a humpback whale. Rept. Provincial Mus. (British Columbia) for 1921, pp. 9–11, pls. I–II. 1922.

ANSON, BARRY J. Selachian "denticles" in the cat. Science, n.s., vol. 60, pp. 528–529. December 5, 1924.

ANTHONY, H. E. Preliminary report on Ecuadorean mammals. No. 6. Amer. Mus. Nov., no. 139, pp. 9. October 20, 1924. (*Scolomys melanops*, gen. et sp. nov.; *Microxus latebricola*, *Œcomys melleus*, *Thomasomys cinnameus*, and *Sturnira ludovici*, sps. nov., *Thomasomys rhoadsi fumeus* and *Oryzomys balneator hesperus*, subsps. nov.)

——— The high Andes of Ecuador. Episodes in the travels of a mammalogist. Nat. Hist., vol. 24, pp. 429–441, 15 figs. July-August, 1924.

ASHBROOK, FRANK G., AND FRANK L. EARNSHAW. Laws relating to fur animals for the season 1924–25. U. S. Dept. Agric., Farmers Bull. 1445, 22 pp. September, 1924.

——— Fur farming. The Farm Journal, vol. 48, no. 10, p. 72. October, 1924.

——— The work of the United States Department of Agriculture relating to fur-bearing animals. Fur Trade Yearbook, vol. 1, no. 1, pp. 43–50. 1924.

BAGG, H. J. AND C. C. LITTLE. Hereditary structural defects in the descendants of mice exposed to X-ray irradiation. Amer. Journ. Anat., vol. 33, pp. 119–146, 3 plates, 1 chart. March 15, 1924.

BAILEY, VERNON. The otter. Nature Mag., vol. 4, no. 4, pp. 237–238. October, 1924.

BAST, T. H. The maxillary sinus of the dog, with special reference to certain new structures, probably sensory in nature. Amer. Journ. Anat., vol. 33, pp. 449–484, 2 text figs., 5 plates. July 15, 1924.

BECKER, ALFRED. Das postembryonale Wachstum des deutschen Schäferhundschaedels. Archiv. f. Naturgeschichte, Abteil. A., vol. 89, Heft 9, pp. 131–197; 18 figs. December 7, 1923.

BEEBE, WILLIAM. A live giant armadillo at last. Zool. Soc. Bull., vol. 27, pp. 118–120, 5 figs. September, 1924. (Specimen arrived at New York Zoological Park.)

BERRY, S. STILLMAN. Observations on a Montana beaver canal. Smithsonian Rept., 1922, pp. 297–308, pls. 6. 1924. (Reprinted with minor changes and additions from Journ. Mamm., vol. 4, no. 2. May, 1923.)

BISSONETTE, THOS. H. The development of the reproductive ducts and canals in the free-martin with comparison of the normal. Amer. Journ. Anat., vol. 33, pp. 267–346, 8 plates. May 15, 1924.

BLAISDELL, FRANK E., SR. Note regarding the treatment of ear canker in rabbits. Science, n.s., vol. 60, pp. 429–430. November 7, 1924.

BURNETT, W. L. The ground squirrels of Colorado. Office Colorado State Entomologist, Circ. 44, 19 pp., illus. November, 1924.

CARPENTER, F. W. A note on the connections, in the mammalian myenteric plexus, between the enteric neurones and extrinsic nerve fibers. Anat. Record, vol. 28, pp. 149–156. July 25, 1924.

CHANDLER, ASA C. Some parasitic round worms of the rabbit with descriptions of two new species. Proc. U. S. Nat. Mus., vol. 66, art. 16, pp. 1–6, pls. 2. November, 1924.

CHAPMAN, ABEL. The borders and beyond: Arctic . . . . Cheviot . . . . Tropic. Gurney and Jackson, London and Edinburgh. xxii, 489 pp., illus. 25 shillings. 1924.

CHIDESTER, F. E. The anatomy of an otocephalic dog. Anat. Record, vol. 28, pp. 1–4, 2 figs. June 25, 1924.

CLARK, W. E. LE GROS. The myology of the tree-shrew (Tupaia minor). Proc. Zool. Soc. London, 1924, pp. 461–497, 24 figs. July, 1924.

COWAN, E. A. An experiment testing the ability of a cat to make delayed response and to maintain a given response toward a varying stimulus. Journ. Comp. Psychol., vol. 3, pp. 1–9. 1923.

CRAIG, W. The dog as a detective. Sci. Monthly, vol. 18, pp. 38–47. 1924.

DAHLGREN, CALVIN A. Fish and game in the Superior. Parks and Recreation, vol. 7, no. 6, pp. 629–634. July–August, 1924.

DAVIS, WILLIAM T. Local notes on the gray squirrel. Proc. Staten Island Inst. Arts and Sci., vol. 2, pp. 126–134. 1924.

DE BEAUX, OSCAR. Beitrag zur Kenntniss der Gattung Potamochoerus, Gray. Zool. Jahrbücher, Abteil. für Systematik, etc., vol. 47, pp. 379–504; 3 figs., plates 4–6. June 25, 1924.

——— Studien über neugeborene Säugetiere (äussere Form). Carnivora fissipedia. Kapitel X u. XI. Zool. Jahrbücher, Abteil. für Systematik, etc., vol. 47, pp. 331–378; 24 figs.; plate 3. June 25, 1924. (Chapters I–IX of these studies appeared in: Archivio Ital. di Anatomia e di Embryologia, vols. 15 and 17.)

DE BURLET, H. M. Zur Innervation der Macula sacculi bei Säugetieren. Anat. Anzeiger, vol. 28, pp. 26–32, 4 figs. July 1, 1924.

DRAHN, F. Varietät der Arteria broncho-oesophagea beim Pferd. Anat. Anzeiger, vol. 58, pp. 173–174, 1 fig. August 15, 1924.

EBERT, HANS. Die Verknöcherung der Rippenknorpel beim Pferd. Jenaische Zeitschr. f. Naturwissenschaft, vol. 60, pp. 127–146; 5 figs., plates 7–8. May 8, 1924.

EDWARDS, JAMES L. Muskrat farming. 62 pp., illustrated. Fur Farms Publishing Co., Utica, N. Y. 1924.

EVARTS, HAL G. Conserving the remnants. Sat. Even. Post., vol. 197, no. 10, pp. 7, 141, 145, 146, 149, 150, illustr. September 6, 1924.

EWING, H. E. Lice from human mummies. Science, n.s., vol. 60, pp. 389–390. October 24, 1924. (Lice from various monkeys are discussed.)

GATENBY, J. B., AND J. P. HILL. On an ovum of Ornithorhynchus exhibiting polar bodies and polyspermy. Quart. Journ. Micros. Sci., vol. 68, pp. 229–238, 1 fig., plate 10. July 1, 1924.

GOLDMAN, E. A. Two new kangaroo rats from Arizona. Journ. Washington Acad. Sci., vol. 14, pp. 372–373. September 19, 1924. (Describes *Dipodomys microps celsus* and *D. ordii cupidineus* from northern Arizona.)

GRAY, MAMIE. Character of the blood-clot in the thyroidectomized adult opossum. Amer. Journ. Physiol., vol. 68, pp. 149–152, 1 fig. April, 1924.

GRAY, PERCIVAL ALLEN. The cortical lamination pattern of the opossum, Didelphys virginiana. Journ. Comp. Neur., vol. 37, pp. 221–264, 31 figs. August 15, 1924.

GRAYBILL, H. W. A new species of round worm of the genus Trichostrongylus from the rabbit. Proc. U. S. Nat. Mus., vol. 66, art. 11, pp. 1–2, 1 pl. October, 1924.

HANNA, G. DALLAS. Temperature records of Alaska fur seals. Amer. Jour. Physiol., vol. 68, pp. 52–53. March, 1924.

HANNA, G. DALLAS, AND MARY E. MCLELLAN. A new species of whale from the type locality of the Monterey group. Proc. Calif. Acad. Sci., ser. 4, vol. 13, pp. 237–241, pls. 5–9. June 14, 1924. (*Balænoptera ryani*, new species, from Monterey Miocene, California.)

HARMER, SIDNEY F. On Mesoplodon and other beaked whales. Proc. Zool. Soc. London, 1924, pp. 541–587, 4 plates, 3 text figs. July, 1924.

HARTMAN, CARL. Vitamin-A and exercise in relation to follicular atresia in the opossum. Amer. Journ. Physiol., vol. 68, pp. 97–101. March, 1924.

——— Observations on the motility of the opossum genital tract and the vaginal plug. Anat. Record, vol. 27, pp. 293–303, 5 figs. May, 1924.

HAUSMAN, LEON AUGUSTUS. Furthur studies of the relationships of the structural characteristics of mammalian hair. Amer. Nat., vol. 58, pp. 544–557, figs. 1–9, pl. 1, table 1. November, 1924.

HELLER, HILDA HEMPL. Peruvian pets. Nat. Hist., vol. 24, pp. 479–493, 14 figs. July–August, 1924. (Includes account of a young *Dinomys*.)

HENTIG, H. V. Reactions of animals to changes in physical environment. I. Animal and earthquake. Journ. Comp. Psychol., vol. 3, pp. 61–71. 1923. (Many animals show abnormal behavior just preceding an earthquake.)

HERRICK, C. JUDSON. The nucleus olfactorius anterior of the opossum. Journ. Comp. Neur., vol. 37, pp. 317–359, 16 figs. August 15, 1924.

HILL, LEONARD. The atmospheric conditions at the Zoological Gardens, London. Proc. Zool. Soc. London, 1924, pp. 333–343. July, 1924.

HINTON, MARTIN A. C. On a new species of Crocidura from Scilly. Ann. and Mag. Nat. Hist., ser. 9, vol. 14, pp. 509–510. October, 1924.

HOFMANN, LOTAR. Zur Anatomie der männlichen Elefanten-, Tapir-, und Hippopotamus-Genitale. Zool. Jahrbücher, Abteil. für Anatomie, etc., vol. 45, pp. 161–212, 1 fig., plates 7–10. November 3, 1923.

HOPKINS, A. E. The appearance of Nissl substance in nerve cells following variations in fixation. Anat. Record, vol. 28, pp. 157–164. July 25, 1924. (Work on white rats.)

HOWELL, A. BRAZIER. Individual and age variation in Microtus montanus yosemite. Journ. Agric. Research, vol. 28, no. 10, pp. 977–1016, pl. 1. June 7 [distributed December], 1924.

HOWELL, ARTHUR H. Revision of the American pikas (genus Ochotona). North Amer. Fauna, no. 47, pp. i–iv, 1–57, 6 plates and 4 figs. in text. August 21 [distributed September 23], 1924. (Recognizes 26 forms from North America, which are referred to 3 species. Two new forms are *Ochotona princeps brooksi* from British Columbia and *O. schisticeps goldmani* from Idaho.)

HUBER, ERNST. Zur Morphologie des M. auriculomandibularis der Säugetiere. Das Experiment als Stütze der morphologischen Muskelforschung. Anat. Anzeiger, vol. 58, pp. 8–26, 8 figs. July 1, 1924.

HUEY, LAURENCE M. A trip to Guadalupe, the isle of my boyhood dreams. Nat. Hist., vol. 24, no. 5, pp. 579–588. September–October, 1924.

JONES, FREDERIC WOOD. The mammals of South Australia. Part II, containing the bandicoots and the herbivorous marsupials (the syndactylous Didelphia). Pp. 133–270; figs. 89–190. Handbooks of Flora and Fauna of South Australia, issued by the British Science Guild (South Australia Branch). Adelaide. 1924.

——— The status of the Kangaroo Island Kangaroo (Macropus fuliginosus Desm.). Proc. Zool. Soc. London, 1924, pp. 451–460, 4 text figs. July, 1924.

KERMODE, FRANCIS. Report of the Provincial Museum of Natural History for the year 1921. Mammals. Rept. Provincial Mus. (British Columbia), 1921, pp. 8–9. 1922.

KINGERY, H. M. The blood supply of the enamel organ in developing molar teeth of mammals. Amer. Journ. Anat., vol. 33, pp. 175–196, 2 plates. May 15, 1924. (Work on white rat, pig, and man.)

KITTREDGE, E. Some experiments on the brightness value of red for the light-adapted eye of the calf. Journ. Comp. Psychol., vol. 3, pp. 141–145. 1923.

KROSZ, KARL. Die Rhizopodenfauna des Pferdekotes. Archiv. f. Protistenkunde, vol. 48, pp. 316–341. July 15, 1924.

KUHLENBECK, H. Über den Ursprung der Basalganglien des Grosshirns. Anat. Anzeiger, vol. 58, pp. 49–74, 8 figs. July 22, 1924. (A comparative study.)

LANG, HERBERT. Into the interior of British Guiana. Nat. Hist., vol. 24, pp. 467–478, 14 figs. July–August, 1924.

LENEVE, LANS. The gray wolves' last stand. Oregon Sportsman, vol. 1, no. 1, p. 17, 1 fig. September, 1924. (Wolves in the Cascade Range.)

LINCOLN, FREDERICK K. Proceedings of the Biological Society of Washington. Author index volumes 1 to 35, 1881–1922. Pp. 98. 1924. (This valuable index is sold by the Society at $2 per copy.)

LONG, J. A. Rat cages of simplified construction. Anat. Record, vol. 28, pp. 119–206, 10 figs. August 25, 1924.

LUCAS, FREDERIC A. The seal collection, a feature of the Hall of Ocean Life, American Museum. Nat. Hist., vol. 24, no. 5, pp. 589–593. September–October, 1924.

MILLER, GERRIT S., JR. The characters and probable history of the Hawaiian Rat. Bernice P. Bishop Museum, Bull. 14, pp. 3–6. October, 1924.

——— A second instance of the development of rodent-like incisors in an artiodactyl. Proc. U. S. Nat. Mus., vol. 66, art. 8, pp. 1–3, pl. 1. October 13, 1924.

——— Some hitherto unpublished photographs and measurements of the Blue Whale. Proc. U. S. Nat. Mus., vol. 66, art. 7, pp. 1–4, pls. 1–9. November 3, 1924.

——— A Pollack Whale from Florida presented to the National Museum by the Miami Aquarium Association. Proc. U. S. Nat. Mus., vol. 66, art. 9, pp. 1–15, pls. 1–22. December 11, 1924.

MILLS, DAVID C. Deadly effect of forest fires on fur-bearers. Parks and Recreation, vol. 7, no. 6, pp. 636–638. July–August, 1924.

MOODY, ROY L. Paleopathology: an introduction to the study of ancient evidences of disease. Univ. of Illinois Press, Urbana, Illinois, 567 pp., 117 pls., 49 figs. 1923.

MORRIS, FRANK. W. H. Hudson, the naturalist (1841–1922). Canadian Field-Nat., vol. 38, pp. 24–26, 51–54. 1924.

MUDD, STUART. Electric transport of fluid across mammalian serous membranes. Science, n.s., vol. 60, pp. 527–528. December 5, 1924.

NEALE, GEORGE. The future of the beaver. California Fish and Game, vol. 10, pp. 114–115. July, 1924.

——— Loss of deer in the canal of the Western States Gas and Electric Company, El Dorado County. California Fish and Game, vol. 10, pp. 115–119, figs. 25–27. July, 1924.

NELSON, E. W. Report of Chief of Bureau of Biological Survey. pp. 39. U. S. Dept. Agric., Washington, D. C. December 2, 1924.

OSGOOD, WILFRED H. Review of living caenolestids with description of a new genus from Chile. Field Mus. Nat. Hist. publ. 222, zool. ser. vol. 14, no. 2, pp. 165–172, pl. 23. October 20, 1924. (*Rhyncholestes raphanurus* gen. et sp. nov.)

PENFIELD, WILDER G. The cranial subdural space. (A method of study.) Anat. Record, vol. 28, pp. 173–175. July 25, 1924.

POCOCK, R. O. Some external characters of Oryceteropus afer. Proc. Zool. Soc. London, 1924, pp. 697–706, 5 figs. September, 1924.

——— The external characters of the pangolins (Manidæ). Proc. Zool. Soc. London, 1924, pp. 707–723, 8 figs. September, 1924. (New generic names: *Paramanis*, type, *M. javanica;* and *Uromanis*, type, *M. longicauda.*)

POHL, HANS. Über das Epithel in den Samenblasen des Meerschweinchens. Anat. Anzeiger, vol. 57, pp. 266–270, 2 figs. April 21, 1924.

POTTER, LAURENCE B. Badger digs for bank swallows. Condor, vol. 26, p. 191. September, 1924.

PREBLE, E. A. ("EDWARDS, P. A.") A stranded whale. Nature Mag., vol. 4, no. 4, pp. 208, 212. October, 1924.

RASMUSSEN, A. T. The hypophysis cerebri of the woodchuck (Marmota monax) with special reference to hibernation and inanition. Endocrinology, vol. 5, pp. 33–66. January, 1921.

RIESE, W. Zur vergleichenden Anatomie der striofugalen Faserung. Anat. Anzeiger, vol. 57, pp. 487–494, 5 figs. June 12, 1924.

ROGERS, C. GILBERT. Large Kashmir stag head (Cervus cashmirianus). Journ. Bombay Nat. Hist. Soc., vol. 26, pp. 1038–1039. January 31, 1920.

ROGERS, FRED T. An experimental study of the cerebral physiology of the Virginia opossum. Journ. Comp. Neur., vol. 37, pp. 265–316, 6 plates. August 15, 1924.

ROMELL, L. G. Voles as a factor in plant ecology. Svensk Bot. Tidskr., vol. 15, pp. 43–45. 1921.

ROMER, A. S. The lesser trochanter of the mammalian femur. Anat. Record, vol. 28, pp. 95–102, 3 figs. June 25, 1924.

Russell, George W. Menace of deer killing dogs. Oregon Sportsman, vol. 1, no. 1, pp. 20–21, 1 fig. September, 1924.

Schaeffer, J. Parsons, and H. E. Radasch. On the obliteration of the lumen of bloodvessels. IV. The origin and nature of the mass which comes to occupy the lumen of an artery segment between two ligatures. Amer. Journ. Anat., vol. 33, pp. 219–242, 6 plates. May 15, 1924. (Work on rabbit.)

Schander, R., und R. Meyer. Zur Bekampfung der Feldmäuse. Archiv. f. Naturgeschichte, Abteil. A, vol. 89, Heft. 9, pp. 1–130, 4 figs. December, 1923.

Schmidt, W. J. Über das Dentin von Bradypus tridactylus. Anat. Anzeiger, vol. 58, pp. 97–107, 6 figs. August 5, 1924.

Schultz, Adolph H. Growth studies on primates bearing upon man's evolution. Amer. Journ. Phys. Anthr., vol. 7, pp. 149–164, 9 figs. April–June, 1924.

——— Observations on Colobus fetuses. Bull. Amer. Mus. Nat. Hist., vol. 49, pp. 443–457, 5 figs. September 5, 1924.

Schumacher, S. Eine "Lippenplatte" beim Eichhörnchen (Sciurus vulgaris L.) Anat. Anzeiger, vol. 58, pp. 75–80, 3 figs. July 22, 1924.

Shapiro, Boris. On the epithelial fibres in the skin of mammals. Quart. Journ. Micros. Sci., vol. 68, pp. 101–145, 17 figs., plate 3. April, 1924.

Sonntag, Charles F. The morphology and evolution of the apes and man. John Bale Sons and Danielsson, Ltd., London, 1924, pp. I–XI, 1–364, figs. 1–57. 1924.

——— On the anatomy, physiology, and pathology of the orang-outan. Proc. Zool. Soc. London, 1924, pp. 349–450, 30 text figs., 4 plates. July, 1924.

——— The comparative anatomy of the tongues of the Mammalia. X. Rodentia. XI. Marsupialia and Monotremata. Proc. Zool. Soc. London, 1924, pp. 725–755, 14 figs. September, 1924.

Spencer, L. T. Central inhibition in the albino rat. Journ. Comp. Psychol., vol. 3, pp. 389–408, 2 figs. 1923.

Stejneger, Leonhard. A chapter in the history of zoological nomenclature. Smithsonian Misc. Coll., vol. 77, no. 1, pp. 1–21. August 30, 1924. (How the International Code was made.)

Stiles, C. W. Notice to zoologists of generic names to be inserted in the official list. Science, n.s., vol. 60, pp. 384–385. October 24, 1924. (Numerous mammal names are included.)

Stone, Calvin P. Further study of sensory functions in the activation of sexual behavior in the young male albino rat. Journ. Comp. Psychol., vol. 3, pp. 469–473, 2 figs. 1923.

Sumner, F. B. The stability of subspecific characters under changed conditions of environment. Amer. Nat., vol. 58, pp. 481–505. November, 1924.

Taylor, Walter P. Bannertail of the Bajadas. Nature Mag., vol. 4, no. 3, pp. 180–182, 188. September, 1924. (Popular account of kangaroo rat.)

Taylor, Walter P., and J. V. G. Loftfield. Damage to range grasses by the Zuni prairie dog. U. S. Dept. Agric., Dept. Bull. no. 1227, pp. 1–15. pls. 1–6. August 10, 1924.

THOMAS, OLDFIELD. Nomina conservanda in Mammalia. Proc. Zool. Soc. London, 1924, pp. 345–348. July, 1924.

———— New Callicebus, Conepatus, and Œcomys from Peru. Ann. and Mag. Nat. Hist., ser. 9, vol. 14, pp. 286–288. September, 1924.

———— A new subspecies of Nyctinomus australis. Ann. and Mag. Nat. Hist., ser. 9, vol. 14, pp. 455–456. October, 1924.

TOWNSEND, CHARLES HASKINS. The northern elephant seal and the Guadalupe fur seal. Nat. Hist., vol. 24, no. 5, pp. 567–578. September–October, 1924.

VAN DER KLAAUW, C. J. Über das Skelettstückchen von Paauw und den Verlauf der Chorda tympani bei einigen Marsupialia. Anat. Anzeiger, vol. 57, pp. 240–246. February 25, 1924.

VAN GELDEREN, CHR. Zur vergleichenden Anatomie des Sinus durae matris. Anat. Anzeiger, vol. 57, pp. 472–487, 2 figs. June 12, 1924. (Work particularly on mole.)

WARTHIN, ALFRED SCOTT, ESTELLA BUFFINGTON, AND RUTH C. WANSTROM. A study of rabbit spirochetosis. Journ. Infect. Diseases, vol. 32, pp. 315–332, pls. 1–12. 1923.

WATSON, HUGH. The application of the Law of Priority. Ann. and. Mag. Nat. Hist., ser. 9, vol. 14, pp. 328–337. September, 1924.

WHITE, ALFRED E., AND EDWARD C. TOLMAN. A note on the elimination of short and long blind alleys. Journ. Comp. Psychol., vol. 3, pp. 327–331, 1 fig. 1923. (Study of learning process in rats.)